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THE MECHANICAL EQUIVALENT OF LIGHT.

Among the many uncertainties in the science of illumination, an accurate knowledge of the value of the mechanical equivalent of light is one. Various have been the attempts to determine this quantity, but in all of them certain assumptions were made which necessarily detract from the accuracy of the result. On the other hand, since light is a physiological phenomenon, a definite ratio between the effect produced and the cause may not exist. This difficulty is overcome by eliminating the eye and measuring merely the energy contained in the visible radiations, which we call light, and comparing this energy with the total energy radiated by the source of light. This ratio is not, in one sense, a true mechanical equivalent of light, but this convention has been generally accepted as satisfactory.

Neglecting, however, the errors introduced by the definition of the ratio, there are other and serious difficulties in making any accurate measurements of the ratio of the luminous to the non-luminous radiations. That value most generally accepted up to the present time was determined by Angström, but previous to his work the luminous efficiency, as this ratio has been designated, had been determined by Nichols, Coblentz, Thomson and others. The methods consisted, in general, of measuring, by means of a thermopile, or some other device sensitive to heat radiation, the total radiation from a luminous source, and then, by a suitable screen, cutting off all except the visible radiation, the energy of which is measured alone. The ratio of the energy measured in the latter case to that in the former is taken to be the luminous efficiency of the source. The visible rays may be separated from the non-visible either by an absorbing screen or a prism.

The latest determination of this mechanical equivalent has been made by Dr. C. V. Drysdale and Mr. A. C. Jolley, who described their results at a recent meeting of the Royal Society of London. The method employed was to separate the visible and the non-visible radiations by means of the prism, and to measure, by means of a bolometer, the radiant energy. This was done, both for the total radiation—that is the white light, which includes all the visible colors—and for the different parts of the spectrum. The results obtained agree well with those resulting from Angström's work. The latter gave, as the mechanical equivalent of light from the Hefner standard lamp, 0.121 watt per candle-power. Dr. Drysdale and Mr. Jolley have obtained 0.119 watt per candle as the mechanical equivalent of the light from the Nernst glower. The close agreement here with Angström's value is probably accidental, since,

necessarily, errors were present which were probably greater than the difference between the two figures. One of these, the loss of energy due to convection currents, was determined approximately, and it was found that about three per cent of the heat from the lamps was carried off by the air and not measured by the bolometer.

The mechanical equivalent for the light from an arc lamp was found, by Dr. Drysdale, to be 0.08 watt per candle. For those rays of light to which the eye is most sensitive, the mechanical equivalent was 0.0598. It is hardly necessary to say that every quality of light has its own mechanical equivalent, and that there is a fixed value only so long as the quality of light itself is fixed.

These values for the mechanical equivalent of light stand in rather sharp contrast to the so-called efficiency of our electric lamps. The newer forms of incandescent lamps are said at best to give a luminous efficiency of one watt per candle, which, compared with the mechanical equivalent for a Nernst filament, gives an efficiency of transformation from electrical energy into light of twelve per cent. Even with the more efficient vapor lamps, the efficiency is still regrettably low. Just what it is can not be said, since we have not at hand any value for the mechanical equivalent of light of this color. But, comparatively speaking, it is probably not very much greater than that of the most efficient of the new incandescent filaments. Evidently we still have a wide field for improvement in electric lamps, and the fact that, as a rule, they are more efficient sources of light than other illuminants is no excuse for not doing better, as it must not be forgotten that the electric system is subject to other losses and to expenses with which some other systems are not burdened.

THE PRESSURE OF ENCLOSED FUSES.

No auxiliary piece of electrical apparatus deserves closer study under modern operating conditions than the enclosed fuse. It is not too much to say that the fuse question is as important in the low tension indoor field as the lightning arrester is in the out-of-door high-voltage work so much discussed at the present time. It is a difficult matter to investigate the physical behavior of enclosed fuses in commercial service, but under proper laboratory conditions, with refined methods of measurement, a great deal can be learned about the performance of fuses in the few thousandths of a second which they last when subjected to a heavy short-circuiting current. Some very valuable thesis work has been done in this direction within the past year or two at the Massachusetts Institute of Technology.

With respect to the pressure in enclosed fuses during the period of rupture under short circuit, it is desirable to know not only the magnitude of the expulsive force, but also the time required for the fuse to blow, the character of material used in the filling of the cartridge, the composition of the fusible strip or wire, and the current and electromotive force waves at the time of action. Prompt and reliable protection of the apparatus behind the fuse is the most important point to secure in commercial service, but if this can be insured without the ruining of the cartridge and its contents for future use, an additional gain will be made. Research on the fuse problem is therefore a benefit to both manufacturer and consumer.

The most satisfactory method of measuring the pressure variations, current and voltage charges in enclosed fuses during the time of action, is to employ an oscillograph with separate mirrors for current and potential, and to use a capsule with diaphragm and a third mirror to record the expulsive pressure of the fuse explosion upon the same photographic film which receives the current and voltage traces. By cutting a small hole in the fuse cartridge and inserting a tube, the pressure wave, which occurs at the instant the fuse blows can be transmitted to the diaphragm fixed in the capsule outside, causing the diaphragm to bulge slightly and giving an angular motion to the attached mirror, which deflects a spot of light on the oscillograph film. Such an apparatus can be calibrated by an ordinary commercial pressure gauge tester, and by the use of a standard direct-current German silver shunt, the oscillograph deflections can be translated in terms of the total current flowing in the fuse under test. This was the general method followed in the tests above mentioned, air being found to be the best medium for transmitting the explosive wave.

Even with enclosed fuses designed for as low a potential as 250 volts the mechanical pressure inside the cartridges at the moment of rupture has been found to run often from 350 to 450 pounds to the square inch. It appears to make little difference in the value of the maximum pressure, whether a fuse built for this potential has a rated capacity of fifty or 100 amperes. The maximum current on short circuit may easily rise to 3,000 or even 5,000 amperes, depending upon the fuse capacity, and the momentary potential may increase forty or fifty per cent above the normal line voltage during the ten or fifteen thousandths of a second which the blowing of the fuse requires. Mechanical strength in a fuse is clearly a desirable feature of construction in the face of such facts.

In view of the fact that an increase in atmospheric pressure reduces the length of a disruptive spark, it would naturally be expected that a fuse showing a higher mechanical pressure in rupture would glow more quickly than one giving a lower pressure. As far as experiments have been carried, however, it has yet to appear that a general relation exists between the time of blowing and the magnitude of the pressure. Thus, in one case a 100-ampere fuse, having a maximum pressure of 350 pounds per square inch blew in almost exactly the same time as a similar 100-ampere fuse having a pressure of 420 pounds, and in another instance a fuse which showed about the same maximum pressure as another took twice as long to blow. In both instances the fuses were of the same make. Low-capacity fuses, however, were invariably found to blow more quickly and with a lower maximum current. It appears from a careful study of oscillograph records that the current wave in the fuse has a tendency to return nearly to zero before the pressure wave gets well started, though after the latter begins

to rise it may easily reach its maximum in two or three ten-thousandths of a second, falling off in a hyperbolic curve closely resembling the expansion of steam in an engine cylinder, but lasting only one or two thousandths of a second. With such a lagging of the pressure wave behind the current wave it would seem that instead of the pressure exerting any choking effect on the arc, the pressure is a direct result of the arc. The magnitude of the pressure seems to be about in proportion to the volume of current, which is to be expected, since the intensity of vaporization of the fuse material would naturally increase or decrease with the strength of current.

EFFICIENCY OF LIGHTING SYSTEMS.

Too frequently is the reader of articles and discussions on problems of illumination confronted with the difficulty of finding out what the writer wishes to say. Not only are terms used loosely, but certain words are much overworked and are used to convey too many meanings; with the result that the reader may not know, until he reaches the end of the sentence, what particular thing, or effect, is referred to. The science of illumination is not alone in this unfortunate condition. Even the highly systematized science of electricity suffers from carelessness, or ignorance, in this respect. Such words as "field" and "capacity" are given a multitude of meanings and are never definite if not qualified. Yet, unfortunately, some speakers and writers comparatively seldom qualify such terms; and then, perhaps, they wonder why others can not grasp at once the meaning of a statement, which seems so clear to them.

Two of the abused words which are thus used in illuminating discussions are "light" and "efficiency." The former, according to the context, may designate a radiation of energy, or the lamp which gives rise to this radiation, or the lamp and fixture as a whole, or even the entire system of illumination. And the term efficiency is just as roughly handled. What thought, for instance, was conveyed to the reader by the title of this editorial? Was it the intention to compare certain of the newer types of lamps, or methods of arranging lamps so as to throw a given amount of light on the objects to be illuminated, or on the comparative effectiveness of various arrangements of lamps for special kinds of work?

The idea really was to call attention to certain physical principles which, as is true of the term, "efficiency," are too often abused. One of these is the so-called "inverse square law," which states that the intensity of illumination of a surface is inversely proportional to the square of the distance from that surface to the source of light. It is true only when all the light which falls on the surface comes from a point. Practically, it holds for nearly all of our more common sources of light when used in the ordinary way, and when not modified by shades or reflectors. But when the luminous source has considerable dimensions, as compared with the distance of the surface illuminated from the source, or when the light comes from a number of lamps, the law is no longer true and it may not hold even approximately. Many do not realize this, and consequently it is said that an arrangement of lamps which brings them closer to the surface to be lighted is more efficient than one in which they are placed higher.

Now, if the ceiling of the room were itself the source of light, the intensity of illumination at the floor would not be affected by the height of the ceiling. And the same is true when the light comes from many small lamps, instead of from a continuous luminous surface. In the former case, the higher the ceiling the larger the portion of it which is effective in illuminating a certain spot; and in the latter, the higher the lamps the more of them which are effective in the same way. The effect is most clearly understood by considering the quantity, or flux, of light which is produced. If this is all thrown on the floor, it makes no difference how far it travels before it gets there, the quantity of light falling on a unit of area will be the same, and this is, of course, the definition of the intensity of illumination. For example, a projector, if it could be made to give a truly parallel beam, would give the same intensity of illumination at all distances from it. In practice, we do not have a luminous ceiling, and when lamps are used, even with reflectors, the total flux of light is not thrown on the floor. Hence, the intensity of illumination on the floor, or at any other horizontal plane, will be affected somewhat by the height of the ceiling. But this effect will generally be much less than those due to other peculiarities, when a decent offer to secure uniform illumination has been made. In other words, it is the effectiveness, rather than the efficiency, which is changed by the position of the lamps. It may be that uniform illumination is not wanted, but an intense illumination on the work; and frequently shadows and cross-lights give trouble, which would not be so if each worker had his own lamp. It is such considerations as these which give rise to confusion when subjects of illumination are under discussion. The remedy is, of course, clearer thinking, and a more definite use of terms. Get a clear understanding of the laws of illumination, and do not make a statement which may convey a dozen different meanings.

THE DECOMPOSITION OF PLATINUM.

The statement issued by Dr. Theodore Grosse, the noted German chemist, that he has been successful in an attempt to break up platinum, as explained elsewhere in this issue, should not be allowed to lead to a confusion of this experiment with the work that has apparently been done by Sir William Ramsay. The former, by a reaction in which he employed an electric current, seems to have extracted from platinum a hitherto unknown substance which possibly contains a new element. Ramsay, on the other hand, by employing a radioactive emanation, believes he has converted copper into lithium; that is, he has transmuted one known element into another, which is an entirely different effect. The breaking up of what were believed to be elements has been a not unusual way of discovering new ones. Ramsay, however, claims the distinction of having been the first to bring about a true transmutation.

THE BEST MULTIPLE-SERIES ARRANGEMENT.

BY HUGH S. BROWN, FIRST LIEUTENANT COAST ARTILLERY CORPS.

Although this subject "has been thrashed out in most of the text-books," I believe this is an original and theoretically accurate method of determining a practical rule for the best multiple-series arrangement for any given number of cells.

It is often desirable to know what is the best arrangement for a number of cells in multiple series, with a view to obtaining the maximum current through a given circuit or for purposes of economy or in consideration of both.

Considering the question of maximum current alone, we will assume the following authoritative formula:

$$C = \frac{n\,E}{\frac{n\,r}{p} - R} = \frac{p\,n\,E}{n\,r - pR}$$

in which C represents the current in amperes; R, the external resistance of the circuit; r, the internal resistance of one cell; n, the number of cells in series; p, the number of cells in parallel; and E, the voltage of one cell.

Differentiating the above equation, it becomes

$$d\,C = \frac{(n\,r + p\,R)\,d\,(p\,n\,E) - pn E\,d\,(n\,r + p\,R)}{(n\,r + p\,R)^2}$$

$$= \frac{(n\,r + p\,R)(n\,E.d\,p + p\,E.d\,n + p\,n.d\,E) - p\,n\,E\,(r.d\,n + n.d\,r + p.d\,R + R.d\,p)}{(n\,r + p\,R)^2}$$

For the first part of the problem, R and r may be considered as constant. Then if the number in parallel only change, the partial differentiation expressing the rate of change in the current is given by the equation

$$d\,C_p = \frac{(n\,r + p\,R)\,n\,E.d\,p - p\,n\,E.R\,d\,p}{(n\,r + p\,R)^2} \qquad (1)$$

If the number in series only change, the equation becomes

$$d\,C_n = \frac{(n\,r + p\,R)\,p\,E.d\,n - p\,n\,E.r\,d\,n}{(n\,r + p\,R)^2} \qquad (2)$$

A comparison of these two equations will produce an equation which is integrable and enables us to determine the proper proportion of cells to be placed in parallel and to be placed in series. This proportion is, as it should be, independent of the voltage.

The equation obtained by dividing (1) by (2) is

$$\frac{d\,C_p}{d\,C_n} = \frac{(n\,r + p\,R)\,n.d\,p - p\,n.R\,d\,p}{(n\,r + p\,R)\,p.d\,n - p\,n.r\,d\,n} = \frac{n^2\,r.d\,p}{p^2\,R.d\,n} \qquad (3)$$

It is evident that, when the rate of change in the current due to an increase in the number of cells in parallel is equal to the change due to an increase in the number of cells in series, the first number of the equation reduces to unity. Such an arrangement of the cells, then, that would produce this ratio would be the best considered from a point of view of the current alone. In other words, we obtain an exact balance; we have no cells "bucking."

Substituting unity for $\frac{d\,C_p}{d\,C_n}$ and transposing with a view to integrating, equation (3) becomes

$$\frac{d\,n}{n^2} = \frac{r}{R}\,\frac{d\,p}{p^2}$$

Integrating this gives

$$\frac{1}{n} = \frac{r}{R}\,\frac{1}{p}$$

or

$$p\,R = n\,r$$

$$p = \frac{n\,r}{R} \qquad (4)$$

For any given number of cells (x), arranged in multiple series, we have the equation

$$x = p\,n$$

$$n = \frac{x}{p} \qquad (5)$$

Substituting this value of n in equation (4)

$$p\,R = \frac{x\,r}{p}$$

$$p^2 = \frac{x\,r}{R}$$

$$p = \sqrt{\frac{x\,r}{R}} \qquad (6)$$

Which means that the square root of the ratio of internal resistance of all the cells to the external resistance of the circuit gives the number of cells to be joined in parallel to give the maximum current.

Similarly

$$n = \sqrt{\frac{x\,R}{r}} \qquad (7)$$

A simple example will suffice.

Given twelve cells; internal resistance of each cell one ohm; external resistance in circuit three ohms. Arrange cells in multiple series for maximum current.

$$p = \sqrt{\frac{12 \times 1}{3}} = \sqrt{4} = 2$$

$$n = \sqrt{\frac{12 \times 3}{1}} = \sqrt{36} = 6$$

For a simple practical rule: Multiply the total number of cells by the $\left\{\begin{matrix}\text{external}\\\text{internal}\end{matrix}\right\}$ resistance of $\left\{\begin{matrix}\text{the circuit}\\\text{one cell}\end{matrix}\right\}$, divide by the $\left\{\begin{matrix}\text{internal}\\\text{external}\end{matrix}\right\}$ resistance of $\left\{\begin{matrix}\text{one cell}\\\text{the circuit}\end{matrix}\right\}$ and extract the square root of the quotient to determine the number of cells that should be in $\left\{\begin{matrix}\text{series}\\\text{parallel}\end{matrix}\right\}$ to obtain the maximum current through the circuit.

For the second part of the problem, we may assume the following authoritative formula:

$$Q = \frac{R}{R + \frac{n\,r}{p}} = \frac{p\,R}{p\,R + n\,r}$$

in which Q represents the efficiency of any arrangement for any circuit and the other factors are the same as before.

Differentiating this, the equation becomes

$$d\,Q = \frac{(p\,R + n\,r)\,(p.d\,R + R.d\,p) - p\,R\,(p.d\,R + R.d\,p + n.d\,r + r.d\,n)}{(p\,R + n\,r)^2}$$

For any given circuit then, which means that R and r become constant, the economic rate of change due to a variation in the arrangement of the cells is expressed by the equation

$$d\,Q = \frac{(pR + nr)R.dp - p\,R\,(R.dp + r dn)}{(p\,R + n\,r)^2}$$

$$= \frac{p\,R^2\,d\,p + n\,r\,R.d\,p - p\,R^2.dp - pr\,R.dn}{(p\,r + n\,r)^2}$$

$$= \frac{r\,R\,(n.d\,p - p.d\,n)}{(p\,R + n\,r)^2} \qquad (8)$$

Which means that the maximum economic rate of change is reached when no change is made in the number of cells in series; in other words, when $d\,n = 0$.

$$d\,Q = \frac{r\,R\,n.d\,p}{(p\,R + n\,r)} \qquad (9)$$

That any parallel arrangement is the most efficient, considered only from an economical point of view, the statement

contained in equation (9) is thoroughly understood by all.

Now it is evident that if, for p, its value obtained for a maximum current arrangement be substituted in equation (9) and the equation then integrated for maximum efficiency and solved for n, we will obtain a compensating value of n which will express the number of cells to be placed in series to produce the greatest current possible at the least cost.

$$d\,Q = \frac{r\,R\,n.d\,p}{\left\{\left[\frac{n\,r}{R}\right]R + n\,r\right\}^2} = \frac{r\,R\,n.d\,p}{4\,(n\,r)^2} = \frac{r\,d\,p}{4\,n\,r} \qquad (10)$$

$$Q_{max.} = \frac{R\,p}{4\,n\,r} \qquad (11)$$

Since efficiency is merely a ratio or percentage obtained for comparison, the maximum of which is 100 per cent or unity, equation (11) may be written:

$$1 = \frac{R\,p}{4\,n\,r}$$

$$4\,n\,r = R\,p$$

But since for any given number of cells $p = \frac{x}{n}$, we can substitute its value and solve for n

$$4\,n\,r = R\,\frac{x}{n}$$

$$4\,n^2\,r = R\,x$$

$$n^2 = \frac{R\,x}{4\,r}$$

$$n = \frac{1}{2}\sqrt{\frac{R\,x}{r}} \qquad (12)$$

Which means that one-half the number of cells placed in series to give maximum current in any given circuit is the number that will give the greatest current at the least expense.

Similarly

$$p = 2\sqrt{\frac{x\,r}{R}} \qquad (13)$$

For a simple practical rule: To determine the number of cells to be placed in $\left\{\begin{matrix}\text{series}\\\text{parallel}\end{matrix}\right\}$ to obtain the greatest current at the least expense: Multiply the total number of cells by the $\left\{\begin{matrix}\text{external}\\\text{internal}\end{matrix}\right\}$ resistance of $\left\{\begin{matrix}\text{the circuit}\\\text{one cell}\end{matrix}\right\}$, and divide the product by the $\left\{\begin{matrix}\text{internal}\\\text{external}\end{matrix}\right\}$ resistance of $\left\{\begin{matrix}\text{one cell}\\\text{the circuit}\end{matrix}\right\}$, extract the square root of the quotient and multiply by $\left\{\begin{matrix}\text{one-half}\\\text{two}\end{matrix}\right\}$.

Practically plotted curves prove the equations.

The New Franchise of the Chicago Telephone Company.

As was announced last week, the Chicago Telephone Company has been granted a new franchise to operate a telephone system in the city of Chicago, Ill. The ordinance was signed by Mayor Busse on November 11, and the franchise will be in effect as soon as it is accepted by the company, which must be done within thirty days after its signing by the mayor.

The Chicago Council Committee on Gas, Oil and Electric Light had the advice of a commission of experts consisting of D. C. Jackson, W. H. Crumb and G. W. Wilder, on the subject of telephone service. The ordinance just passed is the result of this commission's work. The company is given permission to operate a telephone system until January 8, 1929, and is to pay to the city semi-annually three per cent of the gross receipts of all its telephone business, both inside and outside of the city. The books must be kept in a form prescribed by the city comptroller, and the city has the right to inspect, at any time, all the records.

The city council may, after thirty months from the acceptance of the ordinance by the company, change any of the rates charged for any kind of service, the new rate to be in effect for the following five years. Thirty days' notice must be given by the comptroller if the council desires to change the rates. The company must provide the comptroller with all records and data to assist in establishing reasonable rates. If the company is not sustained by the courts in a contest over new rates, the company shall refund all excess charges to subscribers, together with five per cent interest thereon.

Free use of the company's poles or conduits is given for city fire and police telegraph wires.

The city is to have an unlimited number of free telephones in the city hall, and in all other municipal buildings or offices, at a discount of twenty-five per cent from current rates. Ward yards, police stations and fire stations will have free service for incoming messages only, and the board of education secures, by contract, free unlimited-service telephones at schools and offices. City officers or employés are prohibited from free service.

Single-party business telephones, for unlimited use, are given a flat rate of $125 a year. Seventy-five dollars is the flat rate for unlimited use in residences, and $56 per year for two-party residence lines. The measured rates for business houses are $60 a year for the first 1,200 calls, three cents each for additional calls up to 3,600, and two cents each for additional calls up to 7,200. A free line is given for every 6,000 calls in excess of 7,200.

An unlimited number of extra single-party lines may be had by measured-service subscribers at $24 a year. Commutation trunk lines for outgoing calls only will be furnished at $1 a day. Subscribers having two or more measured-service lines shall have a switchboard installed free. Local lines from switchboards shall be $1.50 per quarter each.

Combined business and residence service is provided on the prepaid nickel instrument plan. Under this service a single-party line must guarantee twenty cents a day, and a two-party line, twelve and one-half cents each; for residences, two party lines, ten cents a day each, and four-party lines, five cents a day each. Deficiencies in guarantees may be deducted from any surplus accruing in the following sixty days.

The charge for any single message from one telephone within the city to another telephone within the city shall not exceed five cents. Ten cents for the first three and five cents for each additional minute shall be charged for a toll connection to any point within fifteen miles of the city hall, one mile of the city limits, and in Illinois.

The city, on twelve months' notice, may purchase, for municipal operation, the plant and equipment of the company on January 1, 1919, January 1, 1924, or at the expiration of the grant in 1929. The price to be paid shall be the cost of duplicating the equipment, and, if on either of the earlier dates, an additional five per cent shall be paid as compensation for the compulsory sale. The property shall be valued by a board of appraisal, on which the company shall select one member, the city one, and those two a third.

The franchise also lays down specifications for underground circuits and toll and overhead work, and has a clause for the establishment of neighborhood exchanges in certain portions of the city.

The Western Association of Electrical Inspectors.

The accompanying group photograph was made during the convention of the Western Association of Electrical Inspectors at St. Paul, Minn., October 22, 23 and 24. The gentlemen included in the group, reading from left to right, are as follows:

First row—F. H. Moore, W. H. Gilsdorf, John J. Hanley, F. D. Varnam, H. E. Bloomer, Waldemar Michaelsen, H. C. Harris, John O'Brien, Thomas J. Roberts, Mr. Gilbert, C. W. Hurd.

Second row—W. E. Skead, C. E. Bean, H. H. Hornsby, F. E. Hough, ———, W. D. Kurg, F. R. Daniel.

Convention of the Western Association of Electrical Inspectors, St. Paul, Minn., October 22-24.

Third row—A. E. Garland, G. T. Raymond, F. G. Dustin, F. A. Strasweg, L. A. Barley, H. T. Wreaks, John McDugal.

Fourth row—John Berry, Mr. Waller, J. H. Fenton, W. S. Boyd, H. W. Adkins, Dana Pierce.

Chicago Tractions.

Receiver Blair, of the Union Traction, says twenty-two miles of track have been reconstructed at a cost of nearly $2,000,000, in accordance with the provisions of the new ordinance. Mr. Blair says:

"As soon as the Chicago Railways Company gets possession not only will the work on rail-laying be continued, but new cars and other equipment will be bought at once."

Union Traction has bought 118 new cars at an average cost of $6,500 since June 30, 1906.

Chicago City Railway, according to Supervising Engineer Weston, has spent $4,700,000 this year, including expenditures for substations for distributing power, new car houses, underground conduits, track-laying and new cars.

Annual Meeting of Manhattan Railway Company.

At the annual meeting of the stockholders of the Manhattan Railway Company, J. T. Dillon and E. T. Jeffrey were elected directors to fill vacancies on the board. All other directors were reelected. The old officers of the company have been reelected, and R. M. Galloway, A. Skitt, J. T. Terry, Edwin Gould and E. T. Jeffrey have been made an executive committee.

The Manhattan Railway Company reports for the year ended September 30, gross income of $8,816,101, against $8,061,554 for the year ended September 30, 1906, an increase of $754,547. Its net income for the same period was $5,592,595, against $4,859,972, an increase of $732,623. The surplus after the annual dividend amounted to $1,392,595, or 9.32 per cent upon its entire capital stock. The net income of the Interborough Rapid Transit Company for the same period, which income is primarily applicable to the dividends on Manhattan stock, amounted to over thirteen per cent on the entire Manhattan Railway Company's capitalization. The Manhattan Railway Company's balance sheet shows that this company has on hand in cash $1,530,943, and its only current liabilities amounted to $10,586, showing a profit and loss surplus of $8,278,406. The only taxes it has in litigation amount to $19,866.

The Decomposition of Platinum.

It has been announced, through the *Chemiker Zeitung,* that Dr. Theodore Grosse, of Berlin, has, by a combination of physical and chemical forces, brought about the decomposition of platinum, which has been looked upon as a single element. Dr. Grosse announces that when the decomposition of platinum was effected he obtained an unknown chemical element consisting of black crystals, in no way responding to the usual tests of platinum.

His method was as follows: Molten potassium carbonate was subjected to great heat in a platinum vessel. This was, for many hours, subjected to an alternating electric current between platinum electrodes, with the occasional addition of nitre. By this treatment the electrodes were attacked and became coated with needle-shaped crystals of the color of charcoal. At the same time, the platinum vessel and electrodes lost weight and, on extracting the melt, a brown powder free from potash and carbon was obtained. The crystals and powder yielded solutions which were precipitated by sulphuretted hydrogen, but no platinum was present.

THE DIELECTRIC STRENGTH OF INSULATING MATERIALS AND THE GRADING OF CABLES.[1]

(Concluded.)

BY ALEXANDER RUSSELL.

Effect of the Temperature Gradient on the Electric Stress—When a concentric main is carrying a current, the temperature of the dielectric is not uniform owing to the heat generated in the inner conductor. If the dielectric is isotropic, the temperature at any point after the flow of heat has become steady can be readily written down, if we assume that the thermal conductivity k of the dielectric remains approximately constant over the range of working temperatures.

If θ be the temperature of all points at a distance r from the axis of the main, we have, since the heat entering per second an elementary cylinder of the dielectric, coaxial with the main, must equal the heat leaving it,

$$\frac{d}{d\,r}\left(2\,\pi\,r\,k\,\frac{d\,\theta}{d\,r}\right) = 0,$$

neglecting the flow of heat near the ends parallel to the length.

Hence

$$\frac{d\,\theta}{d\,r} = -\,\frac{A}{r},$$

where A is a constant. We have, therefore

$$\theta = \theta_2 + A \log\,(b/r),$$

where θ_2 is the temperature of the outer conductor, the inner radius of which is b.

Let us suppose that the inner conductor, composed of copper, is solid and of radius a and that i is the current density in it. Then if σ be the resistivity of the copper in ohms, we have

$$-\,4.2 \times 2\,\pi\,a\,k\left(\frac{d\,\theta}{d\,r}\right)_{r=a} = (\pi\,a^2\,i)^2\,\frac{\sigma}{\pi\,a^2},$$

and thus

$$A = a^2\,i^2\,\sigma/(8.4\,k).$$

Hence

$$\theta = \theta_2 + (a^2\,i^2\,\sigma/(8.4\,k)\log_\epsilon\,(b/r),$$

and

$$\theta_1 - \theta_2 = (a^2\,i^2\,\sigma/8.4\,k)\log_\epsilon\,(b/a),$$

where θ_1 is the temperature of the surface of the inner conductor.

We have assumed above that the thermal conductivity k of the dielectric does not vary appreciably with the temperatures likely to occur in practice. C. H. Lees (Trans. Roy. Soc., p. 433, Vol. 204A, 1905) has proved that this assumption is permissible for paraffin wax, glycerine and various other insulating materials. There appears to be a slight tendency, however, toward lower conductivity as the temperature increases. G. F. C. Searle (Proc. Camb. Phil. Soc., xiv, 2, p. 189, 1907) has devised an exceedingly simple method of determining the thermal conductivity of india-rubber, the value of which he finds to equal 0.0004 nearly.

To illustrate the values of $\theta_1 - \theta_2$ likely to occur in practice, let us suppose that $b = 1.649$ centimetres, and $a =$ one centimetre. Let us also suppose that the current density i is 150 amperes per square centimetre, that $\sigma = 1.8 \times 10^{-6}$, and that $k = 0.0006$. The author has no trustworthy data with reference to the conductivities of the dielectrics used in actual cables, and so he takes the value of k for paraffin wax, which has been found accurately by Lees (*l.c. ante*). Substituting in the formula, we get

$$\theta^1 - \theta^2 = \frac{(150)^2\,1.8 \times 10^{-6}}{8.4 \times 0.0006} \times \tfrac{1}{2} = 4^\circ \text{ C. nearly.}$$

It is easy to see from the formula for $\theta_1 - \theta_2$ that for a given value of b and for a given current density, the difference of temperature between the inner and outer conductors is a maximum when

$$a = b/\sqrt{\epsilon} = b/1.649 = 0.6065\,b,$$

which is the case we considered. We see, therefore, that the difference of temperature between the inner and outer conductors is probably not greater than ten degrees in the most unfavorable circumstances.

It is known that the dielectric coefficient and the electric resistivity of an insulating material vary rapidly with the temperature. Jona (*l. c. ante*) mentions a case where a rise of temperature of twenty degrees centigrade made the insulation resistance of a paper-insulated cable fall to one-thirtieth of its original value, and even more striking instances could be given. The question of the variation of the dielectric coefficients of dry paper and of solid cellulose has been investigated very thoroughly by A. Campbell.[1] The following table for oven-dried cellulose is taken from his paper:

Temperature Centigrade.	Dielectric Coefficient.	Resistivity 10^6 Megohm-cm
20	6.7	..
25	..	1,600
30	6.8	900
40	7.0	330
50	7.2	125
60	7.3	40
65	..	20
70	7.5	..

Let us suppose that a steady pressure E is applied across the inner and outer conductors of a concentric main having an isotropic dielectric. The momentary stresses set up initially are the same as if the resistivity were infinite. Now imagine that the dielectric is split up into an infinite number of concentric cylindrical tubes, the material of each tube being at the same temperature. Since these tubes form condensers in series between the conductors, the quantity of electricity per unit length in each condenser will be the same, and thus

$$\lambda\,\frac{2\,\pi\,r}{4\,\pi\,d\,r}\,d\,v = \text{constant},$$

where λ is the value of the dielectric coefficient at a distance r from the axis and v is the potential at the same distance.

Hence

$$-\,\frac{d\,v}{d\,r} = \frac{A}{\lambda\,r},$$

where A is a constant. Now λ diminishes as the temperature diminishes, it therefore diminishes as r increases. We see, therefore, that the effect of λ varying with the temperature is to make the electric stress on the dielectric more uniform.

If we assume that λ varies with temperature according to the linear law, we may write

$$\lambda = \lambda_o\{1 + a\,(\theta - \theta_2)\} = \lambda_o\{1 + B \log_\epsilon\,(b/r)\},$$

where $B = a\,a^2\,i^2\,\sigma/8.4\,k$. It readily follows that the electric stress is a minimum where

$$r = b\,\epsilon^{(1-B)/B}.$$

In practice, B is very small compared with unity, and hence the electric stress diminishes as we pass from the inner to the outer conductor.

Let us now suppose that the direct pressure E has been applied sufficiently long to make the electric stresses and the leakage currents assume their steady values. In this case by Ohm's law

$$d\,v \Big/ \left\{\rho\,\frac{d\,r}{2\,\pi\,r} = \text{constant},\right.$$

where ρ is the resistivity in ohms of the dielectric.

Hence

$$\frac{r}{\rho}\,\frac{d\,v}{d\,r} = -\,A',$$

or

$$-\,\frac{d\,v}{d\,r} = \frac{\rho\,A'}{r},$$

where A′ is a constant.

Now ρ increases as the temperature diminishes and therefore as r increases. The variation of ρ, therefore, due to a slight temperature gradient in the dielectric tends again to make the stress more uniform. But if there be a drop of ten degrees centigrade between the inner and outer conductors, the electric stresses on the outer layers of the dielectric when the

[1] Paper read before the Institution of Electrical Engineers of Great Britain, November 14.

[1] Proc. Roy. Soc., A, Vol. lxxviii, p. 196 (1906).

cable is loaded may be much greater than on the inner layers.

It will be seen that the effect of the temperature gradient is to turn the isotropic dielectric into a composite dielectric, and hence it may show the phenomenon of residual charge.

Concentric Main with Composite Dielectric—To simplify the formula, let us suppose that the dielectric consists of two layers of different isotropic insulating materials at the same temperature throughout. Let ρ_2, λ_2 be the resistivity in ohms and the dielectric coefficient of the inner layer next the inner conductor, and let ρ_1, λ_1 be the corresponding quantities for the outer layer. Let r be radius of the cylindrical boundary between the two wrappings. Then if R_1, R_2 be the resistances per unit length to the flow of leakage electric currents across them, and K_1, K_2 be the capacities in farads per unit length of the cylindrical tubes formed by the wrappings, we have[1]

$$R_1 = \frac{\rho_1}{2\pi}\log_\epsilon\frac{b}{r};$$

$$R_2 = \frac{\rho_2}{2\pi}\log_\epsilon\frac{r}{a};$$

$$K_1 = \frac{\lambda_1}{2\log_\epsilon(b/r)}\times\frac{1}{9\times10^{11}};$$

$$K_2 = \frac{\lambda_2}{2\log_\epsilon(r/a)}\times\frac{1}{9\times10^{11}}.$$

Now the leakage current i_R across an isotropic dielectric is in phase with the potential difference applied at its boundaries, and the capacity current i_K is ninety degrees in advance of this potential difference. If v', v, and v'' denote the instantaneous values of the potential of the outer conductor, the boundary between the two media, and the inner conductor respectively, we have

$$i'_R = \frac{v'-v}{R_1}; \qquad i''_R = \frac{v-v''}{R_2};$$

$$i'_K = K_1\frac{d}{dt}(v'-v); \quad i''_K = K_2\frac{d}{dt}(v-v''),$$

where i'_R, i''_R denote the leakage currents, and i'_K, i''_K the capacity currents in the outer and inner media respectively. We also have

$$i'_R + i'_K = i''_R + i''_K = i,$$

since the sum of the leakage and capacity (displacement) currents in each medium must equal the total current flowing across the dielectric.

Let V_1, V_2 denote the effective values of $v'-v$ and of $v-v''$, and let ϕ_1 and ϕ_2 denote respectively the phase-difference between V_1 and V_2, and the effective value of i. Then if f be the frequency and $\omega = 2\pi f$, we have

$$\left.\begin{aligned}\tan\phi_1 &= \omega K_1 R_1 = f\lambda_1\rho_1/(18\times10^{11}),\\ \text{and}\\ \tan\phi_2 &= \omega K_2 R_2 = f\lambda_2\rho_2/(18\times10^{11}).\end{aligned}\right\} \quad (A)$$

If, therefore, $\lambda_1\rho_1 = \lambda_2\rho_2$, V_1 and V_2 are in phase with one another, and thus

$$V = V_1 + V_2,$$

where V is the effective value of the applied potential difference. In general, however, $\lambda_1\rho_1$ is not equal to $\lambda_2\rho_2$, and therefore $V_1 + V_2$ must be greater than V.

Now by reciprocating the well-known formula[1]

$$\frac{A_1}{A} = \frac{\{R_2^2 + L_2^2\omega^2\}^{1/2}}{\{(R_1+R_2)^2 + (L_1+L_2)^2\omega^2\}^{1/2}},$$

for the currents in a divided circuit, we get

$$\frac{V_1}{V} = \frac{\{1/R_2^2 + K_2^2\omega^2\}^{1/2}}{\{(1/R_1+1/R_2)^2+(K_1+K_2)^2\omega^2\}^{1/2}} \quad (1)$$

the formula for the voltages across leaky condensers in series.

By differentiating this expression with respect to ω it is easy to see that V_1 increases with ω when $\lambda_2\rho_2$ is greater than $\lambda_1\rho_1$. In this case the electric stresses in the medium next the outer conductor increase as the frequency increases, and the stresses in the inner medium diminish. If $\lambda_2\rho_2$ were less than $\lambda_1\rho_1$ the converse effects would take place.

We see from (1) that, when $\lambda_2\rho_2$ is greater than $\lambda_1\rho_1$, V_1/V has its minimum value when ω is zero, that is, with steady pressures, and its maximum value when ω is infinite, that is, with an alternating voltage of very high frequency.

The Electric Stresses with Direct and Alternating Pressures—The preceding example illustrates that the electric stresses to which the insulating materials may be subjected with direct and alternating pressures are sometimes quite different. Whether the cables break down sooner with direct or alternating pressures depends on the relative values of the dielectric strengths of the materials which are subjected to the greatest stresses in the two cases. Unless we know the physical constants and the dimensions of the various wrappings, it is impossible to say whether the cable will break down more readily with direct or alternating pressures of the same maximum value.

In the general case, if

$$\rho_1\lambda_1 = \rho_2\lambda_2 = \rho_3\lambda_3 = \dots,$$

the stresses with direct pressure will be the same as with alternating of the same maximum value. Even, however, if this relation between the coefficients were approximately true at the start, it would soon cease to be true owing to the heating of the dielectric. Hence the electric stresses will, in the majority of cases, be different with direct and alternating pressures.

At the moment of switching on the direct pressure the distribution of the electric stresses depends on the dielectric coefficients of the wrappings, but after a few seconds the distribution depends on the resistivities.

With alternating pressures, as the author has previously pointed out, the mere fact that the pressures across the various layers are out of phase with one another may unduly increase the pressure across a particular layer. It is to be noticed also that at the moment of switching on, if the cable is charged, an excessive stress may be thrown on the dielectric. For this reason, especially when testing cables, care should be taken to discharge them before closing the switch.

The Grading of Cables—Let us first consider the grading of cables for use on alternating-current circuits. As early as 1898, Jona had constructed single-core cables, the insulation wrappings of which were arranged so that those nearer the core had greater dielectric coefficients than those more remote. The layers next the core were generally of rubber, and round them were wound layers of paper or jute having smaller dielectric coefficients. The more costly rubber insulation was thus concentrated where its high dielectric coefficient partially relieved the excessive electric stress, and its great dielectric strength enabled it to withstand easily this diminished stress. The value generally accepted for the dielectric strength of pure vulcanized para is fifteen to twenty effective alternating kilovolts per millimetre, or twenty to thirty direct kilovolts per millimetre.

Mervyn O'Gorman (*l.c. ante* p. 636) has shown that to get uniform electric stress we must have at all points in the dielectric

$$\lambda r = \text{constant},$$

where λ is the dielectric coefficient and r the distance of the point from the axis of the cable. He suggests that by suitably "loading" paper insulation an approximation to this ideal cable might be constructed.

Conclusions—(1) When part of the dielectric under stress breaks down, a disruptive discharge ensues only when the effect of this partial breakdown is to increase the electric stress on the remaining portion.

(2) The dielectric strength of air un-

[1] A. Russell, "Alternating Currents," Vol. ii, p. 458.

[1] A. Russell, "Alternating Currents," Vol. i, p. 166.

der given conditions can be found accurately by finding the disruptive voltages between spherical electrodes at distances greater than 0.5 centimetre apart. Under normal conditions it is about 3.8 kilovolts per millimetre.

(3) The dielectric strength of other gases can be found in a similar way experimentally by the help of the tables given in Section 5. Helium has an extraordinary high dielectric strength.

(4) The dielectric strength of oils can be found by noticing the disruptive voltages between spherical electrodes immersed in them, provided that the distance apart is greater than 0.3 centimetre. An excellent way of drying oils is by letting heated air bubble through them.

(5) In finding the dielectric strength of solids it is advisable, when possible, to embed the spherical electrodes in the material under test.

(6) High-pressure concentric cables, having an isotropic dielectric, for a maximum working pressure V should be constructed so that

$$b = a\,\epsilon^{d/a};$$

where V/d is the maximum permissible working stress to which the dielectric may be subjected, b is the inner radius of the outer conductor, and a is the outer radius of the inner conductor. The smallest permissible value of a is d. When the core is stranded it should be encased in a thin lead tube.

(7) The effect of the temperature gradient in the dielectric of a concentric main, when working, is often to make the electric stress between the two conductors more uniform. Jona's experiments indicate that the dielectric strengths of paper-insulated cables do not vary much when the range of temperature does not exceed sixty degrees centigrade. They are probably slightly less at the high temperatures. C. E. Skinner's experiments on glass, treated cloth, mica, etc., show that the dielectric strengths of many insulating materials in the solid form diminish as the temperature rises.

(8) With a composite dielectric subjected to alternating pressures, the potential difference across the layers are usually out of phase with one another. It is only in a limited number of cases, however, that the increase of the stress due to this cause has to be considered, as the leakage currents are usually negligibly small in comparison with the capacity currents.

(9) The effect of alternating and direct pressures in producing stresses in the dielectric are sometimes quite different.

(10) High-pressure cables for alternating or direct-current circuits should be graded so as to make the maximum electric stress on the dielectric as small as possible, and stranded conductors should be encased in thin lead tubes.

Twenty-five Years of Institute History.

At the regular meeting of the Schenectady (N. Y.) chapter of the American Institute of Electrical Engineers, held at Schenectady, November 1, T. C. Martin addressed the members on the subject, "Twenty-five Years of Institute History."

The Institute was already in existence in the minds of its advocates and friends, in 1883, long before the call to arms was sounded which led to its formal inauguration in April, 1884. Mr. Martin was one of the principal assistants to Dr. Nathaniel S. Keith in the preparation of the circular which began the real organization work.

Since the inauguration of the American Institute of Electrical Engineers, fifteen of the past-presidents have been engineers of great distinction, and the names of seventeen are attached to inventions, some of which are the greatest of the last fifty years. Eight of the nineteen past-presidents have followed the profession of teacher, and three have been journalists. Seven of the nineteen, including the present incumbent, were not natives of this country.

Mr. Martin paid a high tribute to Ralph W. Pope, for his efficient services as secretary for the past quarter of a century. The first report presented by Mr. Pope, in May, 1886, showed a total of 250 members. The Institute has now 5,000 members, not including students. The average budget in 1886 was less than $1,000; it is now over $70,000.

While comparisons are not always popular, it is only by noting the progress of other societies that a realization of how far and how fast the Institute has traveled can be had. In the year when the American Institute of Electrical Engineers was organized (1884), the American Society of Civil Engineers had 834 members. At the beginning of October of the present year it had 4,287. The American Institute of Mining Engineers had 1,381. On October 5 of the present year it had 4,179. At the close of 1884 the American Society of Mechanical Engineers had 557 members, and on October 1 of this year it had 3,335 members. The enrollment in the four national technical bodies aggregates about 17,000.

One of the most significant impressions in connection with the growth of the Institute has been its evolutionary character. At the very outset certain elements and essentials were set forth as desirable, and persistently, if unconsciously, the society has pursued the ideas of the founders. A perusal of the earliest volumes of transactions shows emphasis to have been laid upon a library, a permanent home, branches or chapters, raising the character and qualifications of membership, standards of apparatus and tests, securing papers on the latest advances and from representative men, and the interchange of courtesies with domestic and foreign societies.

It is a matter of considerable pride that the Land and Building Fund Committee of the Institute has raised, in three years, from about 1,000 members and friends, the sum of $160,000, nearly all of which is paid in. It is expected that its campaign of lifting the debt for its share of the Engineering Societies Building will be closed this winter by securing the $20,000 still needed.

The joint library in the new Engineering Societies Building given to the national societies by Mr. Carnegie is one of the best evidences of the good that follows from the creation of the new home. There is installed in this library even now, in the earlier stages of organization, the best collection of engineering literature in the world. It is constantly securing valuable accessions, and students more and more frequent it. Together with the grand public library on the next street, now being finished, it will constitute the best centre of scientific and literary investigation through the printed word to be found on this continent. When Past-President Wheeler gave to the Institute the Latimer-Clark Library, he little thought that from such a nucleus, or so soon, would come in reality both the building and the splendid larger library it now enshrines.

With the housing of the Institute in the new building there was some fear that this would make for centralization and for an undue accumulation of power in New York hands. It is a noteworthy fact, however, that never before was the establishment of branches and chapters carried on so strenuously. The vigor of the branches is a cause for profound congratulation, and is the best proof of general health and a pledge of universal interest among widely scattered members of the profession.

Steel Rails.

At the meeting of the Central Railway Club at Buffalo, N. Y., Friday, November 8, Franklin E. Abbott presented a paper entitled "Steel Rails." This paper went into a discussion of the manufacture of steel rails as conducted at the mills of the Lackawanna Steel Company. The ores used at the Buffalo steel plant of the Lackawanna Steel Company come from Pennsylvania, northern Michigan, Wisconsin and Minnesota, with the northern ore in predominance. Statistics of iron ore mining show that fully two-thirds of all rail steel made in the United States comes from Messebe ores. Mining of Messebe ores is a simple process, being visible to the observer from the ground surface. The ore beds are only a shallow depth below the ground surface, the depth in mines now being worked probably not exceeding fifty or sixty feet. The body of earth covering the ore is composed mainly of gravel and boulders, which is stripped from the top of the ore beds by ordinary methods of moving dirt in railroad construction. The ores are loaded on dump cars direct by the steam shovel, and forwarded to the ore docks at Duluth and Superior. From the ore pockets the ore is drawn directly into boats and proceeds at the smelters through the ordinary bessemer steel-producing processes. The processing of the steel in forming the rail was described in detail. The chemical analysis of average bessemer steel rail, as made at present for heavy rails, runs about as follows: carbon, 0.5 per cent; phosphorus, 0.1 per cent; sulphur, 0.08 per cent; silicon, 0.12 per cent; manganese, one per cent; iron, 98.2 per cent. The quantity of carbon can be controlled by the grade of spiegel. Makers and users of rails are not exactly in agreement as to what the limits in carbon should be. Users have been inclined to increase carbon content somewhat faster in proportion than the increase in weight of rails. When a seventy-pound rail was regarded as a heavy section, carbon in the steel ran from 0.35 to 0.40, but when the weights of rails reached 100 pounds per yard, 0.60 carbon was called for, and in some cases the upper limit was fixed at 0.65 per cent. The higher carbon steel, 0.55 per cent to 0.65 per cent, was also specified for lighter rails, such as eighty-pound and eighty-five-pound per yard. The eighty-pound rail was an increase in weight of only fourteen per cent over the seventy-pound rail, but 0.58 carbon, often called for in this weight rail, was an increase of fully forty-five per cent of this element over the lighter section. It can be seen that hardening properties were raised entirely out of proportion with the increased weight, and the apparent consequence was a less satisfactory rail in the heavier sections. With the raising of the carbon content to get more elasticity and better wear, more failures came on through breakage. It was then proposed and specified on the part of the users that phosphorus should be lowered about fifteen per cent, making the limit not to exceed 0.085 per cent. Practically, this can not be done, because of the ore conditions. If all the rail mills in this country were to undertake to fill from American ores the annual requirements of about 3,000,000 tons, under 0.085 phosphorus specifications, for bessemer rail steel, that grade of ore would be exhausted before provisions could be made to meet the yearly demand for rails made by any other process.

If open-hearth steel is to succeed bessemer, it will take a term of years and the expenditure of an enormous sum of money to build furnaces enough to provide the steel needed for rails alone. Before this could be accomplished it is more than probable that the 0.085 per cent phosphorus bessemer ores would run out, and with an inadequate production of open-hearth steel, the railroads would have to get along with a short supply or import the tonnage lacking. To avoid this apparent short-cut to the end of good quality bessemer steel rail, the makers insist that the phosphorus limit shall be left as it has been for a number of years past, at 0.1 per cent, and a somewhat modified carbon content be used.

The wear of the heavier-section rails has not been all that the users expected, even with the proportionally higher carbon, and they are loath to make any recession in this hardening element, fearing that by so doing there will still be greater loss from rapid wear. But the question of safety must have first consideration, and neither the makers nor users of rails will be justified in adding hardening properties to get increased service that will place the material anywhere near the danger line of breakage.

At the present time over seventy-five per cent of the rails used on American railroads are rolled according to the standard shapes and in conformity with the American Society of Civil Engineers' specifications. One of the leading advantages to the manufacturer in the American Society of Civil Engineers' specifications is in the distribution of metal in its different members. In the head there is forty-two per cent; in the web, twenty-one per cent, and in the base thirty-seven per cent.

T-rail thus far made has a greater percentage of metal in the head than in the base. The head is in a mass with less radiating surface than the base. The base is not only smaller, but thinner, besides having a greater radiating surface. It can therefore be readily understood why there is a considerable difference in temperature between the head and the base when the rail goes through the finishing passes. Cambering of rails is made necessary to counteract warping that takes place in cooling. The warping is due mainly to the shape of the section, and the rail is rarely perfectly straight when cold. Whatever warp or crook may be left in must be taken out by cold straightening. This is done in a press under a slow-motion plunger by applying pressure on the rail centrally between bearings forty-two inches apart. It is pretty generally conceded by both rail makers and users that the strain and torture that rails have to endure in cold straightening are the most severe and objectionable work in the whole manufacturing and finishing process.

Mr. Abbott described in detail the various failures which take place in rails in service, and contends that steel rails of American manufacture on American railroads are to-day, in the aggregate, of excellent quality, and are giving splendid service. The proportional tonnage in the whole country that seems to be wearing out too fast is not large. The failed rails, all told, are relatively small in quantity, constituting only a small fraction of one per cent of the tonnage made.

At the present time we seem to have reached one of the transition periods in the manufacture and use of steel rails, in which the rails, as made, do not quite balance with the railroad traffic as it exists. The manufacturer is held by certain limitations in character of raw materials that prevent meeting all that might be desirable in changes of composition of steel for the improvements needed. The railroads can not recede in the matter of heavy loads and fast trains, and must by some means get rails that will hold up to changed conditions as they are. It is believed that a remedy can be obtained by the cooperation of the manufacturers and railroads in bringing out a revised rail section. It is suggested that in comparison with the American Society of Civil Engineer sections, both head and base shall be reinforced, and that the distribution of metal be nearly balanced, making that in the base equal or slightly greater than in the head. It is also proposed that width of base shall be less than height of rail, which will admit of forming thicker flanges. The advantages of a balanced section with comparatively thick base are: first, a lower temperature of the whole section at the final pass, hence a colder finish of the rail head, giving denser and better-wearing material; second, less cambering and better hot straightening, reducing as much as possible the objectionable cold straightening work; third, a reinforced head to provide against splits and other head failures; fourth, a reinforced base to overcome the weakness that seems so prominent in present pattern rails.

Platinum.

The production of platinum in the United States in 1904 was 200 ounces, valued at $4,160; in 1905 the production was 318 ounces, valued at $5,320; in 1906 the platinum production of the country amounted to 1,439 ounces, valued at $45,189, a fourfold increase in quantity and more than eightfold increase in value over the figures for 1905.

The principal feature of interest in the platinum industry during the year was the phenomenal rise in prices for ingot platinum, which, beginning with $20.50 per troy ounce on January 6, 1906, had on November 17 reached $38, remaining at this figure until the end of the year, after which there was another slight rise in price. In February, 1907, for the first time, a distinction was made between ordinary platinum and hard platinum, that is, platinum rich in iridium and asmium, considerable iridium being allowed to remain alloyed in the platinum of the ingots. Such hard platinum was quoted at $41 per ounce on February 23, and this price held until April 6, 1907, when the placing on the market of more than 100 pounds of platinum by a new producer interested in American developments checked the advance, and on May 4, 1907, ordinary platinum was quoted at $32 and hard platinum at $35. Then a gradual decline set in and the present price (October, 1907) is $23 for ordinary and $25 for hard platinum.

In presenting statistics of the platinum industry in 1906 in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," Dr. David T. Day, of the United States Geological Survey, quotes an article by S. I. Gulishambarov, of the Russian ministry of finance, translated in the *Mining Journal* (London), summarizing reasons for the remarkable advance in prices, and a paragraph from that article is requoted here:

"In the twenties of the last century, after the discovery of platinum in the Ural Mountains, the world's output of the metal, according to data collected by the Russian minister of finance, amounted to forty poods (a pood equals a trifle over thirty-six pounds) per annum. The demand for it was, however, so small that the government had to take steps to find a sale for it and began buying it on its own account for coinage. In the sixties of the same century the development of the chemical industries in Western Europe, and later the springing up of electrical engineering and of the dental manufacturing business increased the uses of platinum, but in spite of this the supply was still in excess of the demand."

All this has since changed. Statistics show that the United States, France, Great Britain, Germany and Russia require annually quantities of the metal much larger than are produced, and the present high price is the legitimate result of natural conditions of supply and demand.

The manner of occurrence of platinum in the United States and elsewhere, the methods of its extraction, its physical properties and its uses were summarized by F. W. Horton in a paper in the "Mineral Resources of the United States for 1905."

In the report for 1906 Dr. Day, whose work for the Geological Survey in connection with the experiments on the black sands at Portland, Ore., has done so much to develop platinum mining in the United States into a permanent and profitable industry, calls special attention to the platinum placers of the South American Republic of Colombia, which next to Russia is the most important producer of the mineral, and for the convenience of those who desire further information on the subject he has inserted a number of names and addresses of Colombian gentlemen exceptionally competent to write with authority concerning the platinum resources of their native country.

During 1906 a new concentrating apparatus to use the black sands was installed for the placer interests near Cariboo, Canada, and it is probable that this plant will yield a considerable output in 1907.

The occurrence of platinum in copper-nickel ores in southwestern Utah and eastern Nevada has also been reported, and two companies have begun development work on low-grade copper-nickel ores in the northeastern part of Lincoln county, Nev.

It is interesting to note that the imports for consumption of platinum during the calendar year 1906 were valued at $3,788,759, as against $2,173,623 in 1905, distributed as follows: Unmanufactured, 1,267 pounds, valued at $390,989; ingots, bars, sheets and wire, 10,227 pounds, valued at $3,210,131; vases, retorts and other apparatus, vessels and parts thereof for chemical uses, $186,398; manufactures of, not specially provided for, $1,241.

Alternators for High Frequency Currents.

In his discourse before the British Association for the Advancement of Science, at the recent Leicester meeting, W. Duddell said:

"The simplest, and one of the earliest, methods for producing Hertzian waves for use in wireless telegraphy consisted in charging up, by means of an induction coil, a vertical insulated conductor, which was allowed to discharge itself to earth by means of a spark taking place between its lower end and another conductor which was connected to earth. To detect the Hertzian waves, Marconi employed an improved form of the Branly filings tubes, which is known as the "coherer." In order to transmit messages the radiation is started and stopped so as to form short and long signals, or dots and dashes of the Morse code, out of which the whole alphabet is built up in the well-known way.

"The waves travel with, as far as we know, the same velocity as light—namely, 186,000 miles per second. Between the frequency and the velocity of propogation we have the relationship that the product of the wave-length by the frequency is equal to the velocity of propogation. The wave-lengths which are of practical use in wireless telegraphy at the present time range between 100 metres and 3,000 metres, though, of course, it is quite possible to use, for special purposes, wave-lengths outside these limits. The corresponding frequencies used in practice are, therefore, between 3,000,000 and 100,000 complete periods per second. We require, therefore, to produce in the vertical conductor alternating or oscillating currents of any frequency within this range, and to have a sufficient number of oscillations following one another without interruption to allow of good syntony being obtained.

"Several experimenters have stated lately that they have built alternators giving these high frequencies and a considerable amount of power, but, so far as I am aware, there are no reliable data available as to the design of these machines. If it should prove possible to construct alternators for these very high frequencies, we shall be able to obtain a sufficient number of consecutive oscillations of the current in the aerial, of definite frequency, to enable very sharp syntony to be obtained. Not only will this greatly reduce interference troubles in wireless telegraphy, but such alternators will be of the greatest value for wireless telephony."

Two Unique Electrically Operated Australian Swing-Bridges.

THE accompanying illustration, Fig. 1, shows the controller house of the Pyrmont electrically operated bridge at the inlet of Port Jackson, crossing Darling Harbor in Australia, and extending into the heart of the city of Sydney, while illustration, Fig. 2, shows a similar drawbridge at Glebe Island, also at Sydney, which differs in construction from the Pyrmont bridge in the pivot pier.

The rubble concrete base of the Glebe Island swing-bridge extends to within a foot of low-water mark and there is a sandstone facing from that point to the top of the pier, the sheet piling of the cofferdam having been cut off level with the bed of Darling Harbor.

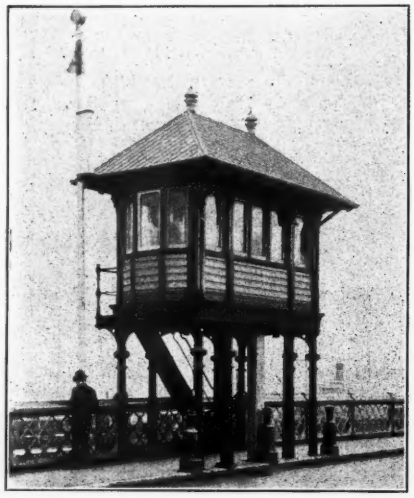


FIG. 1.—CONTROLLER HOUSE OF THE PYRMONT ELECTRICALLY OPERATED SWING-BRIDGE.

There was a space somewhat larger than was actually required for the finished pier first dredged out. A depth of thirty-five feet below low-water mark was excavated, the bottom being of stiff clay and then about 100 piles were driven twenty-five feet, with a follower, the heads finishing two feet and three and one-half feet above the foundation level.

Across the flats, an octagonal cofferdam was constructed forty-eight feet in diameter, this being built around the foundation piles, which consisted of twelve-inch by twelve-inch sheet piles with tongues and grooves formed of four-inch by three-inch Oregon strips spiked to the sides.

It may be stated that the thrust from one wall was balanced by the thrust from the one opposite by arranging the struts symmetrically, while the sets were spaced at varying depths to permit of the same section of timbers being used. Between the cofferdam and the finished outline of the pier a three-foot space was left to permit of the water getting freely to the pumps and prevent risk of water getting below the freshly laid concrete.

The dam proved remarkably tight and necessitated but little pumping in spite of the fact that it was one of the deepest single-wall structures ever constructed, being subject to a head of forty-one feet.

FIG. 2.—THE GLEBE ISLAND ELECTRICALLY OPERATED SWING-BRIDGE.

The sets were easily removed as the rubble concrete within the dam was completed.

Although the weight of the foundation is about ten million pounds, the heavy swing-span has been worked electrically thousands of times at high speeds, with no settlement of the pier. This is, of course, important, as any movement in the foundation would be multiplied at the ends of the swing-span where only an inch is available when swinging. There are great stone banks on either side of the Glebe Island bridge, as noted in illustration, Fig. 2. The width of base is seventy-five feet and the height seventy feet. The two banks contain nearly a quarter of a million cubic yards of stone and it is stated that 200 million pounds of soft material, overlaying the solid clay was removed by dredging.

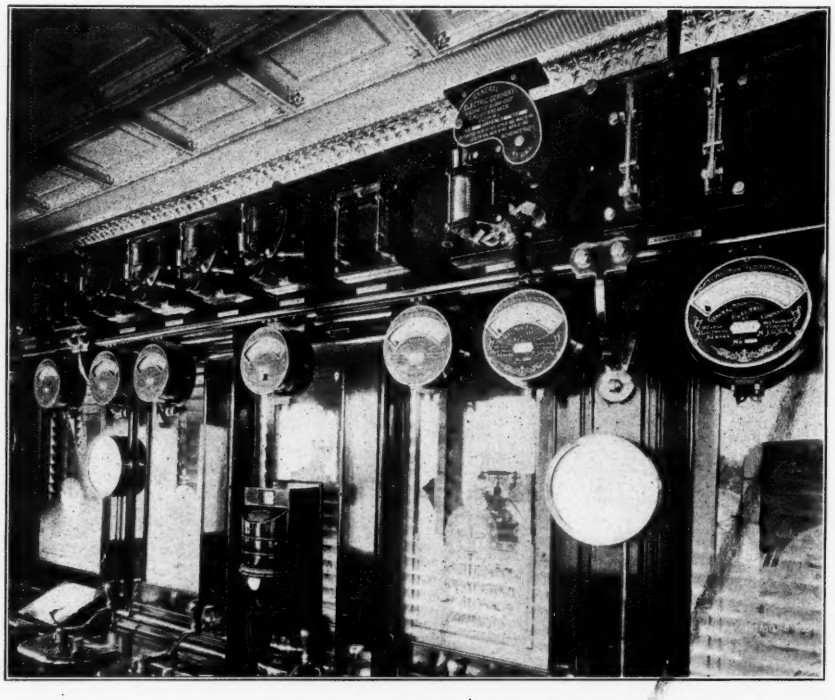


FIG. 3.—INTERIOR OF CONTROLLER HOUSE, PYRMONT ELECTRICALLY OPERATED SWING-BRIDGE.

The banks are faced with stone pitching from low-water mark, finished at the top with heavy stone coping which is in keeping with the handsome abutments at the

ends of the bridge. The swing-span weighs 650 tons and is very much similar to the Pyrmont electric swing-bridge. The electrical operation of the Glebe Island bridge is similar to that of the Pyrmont swing-bridge described below.

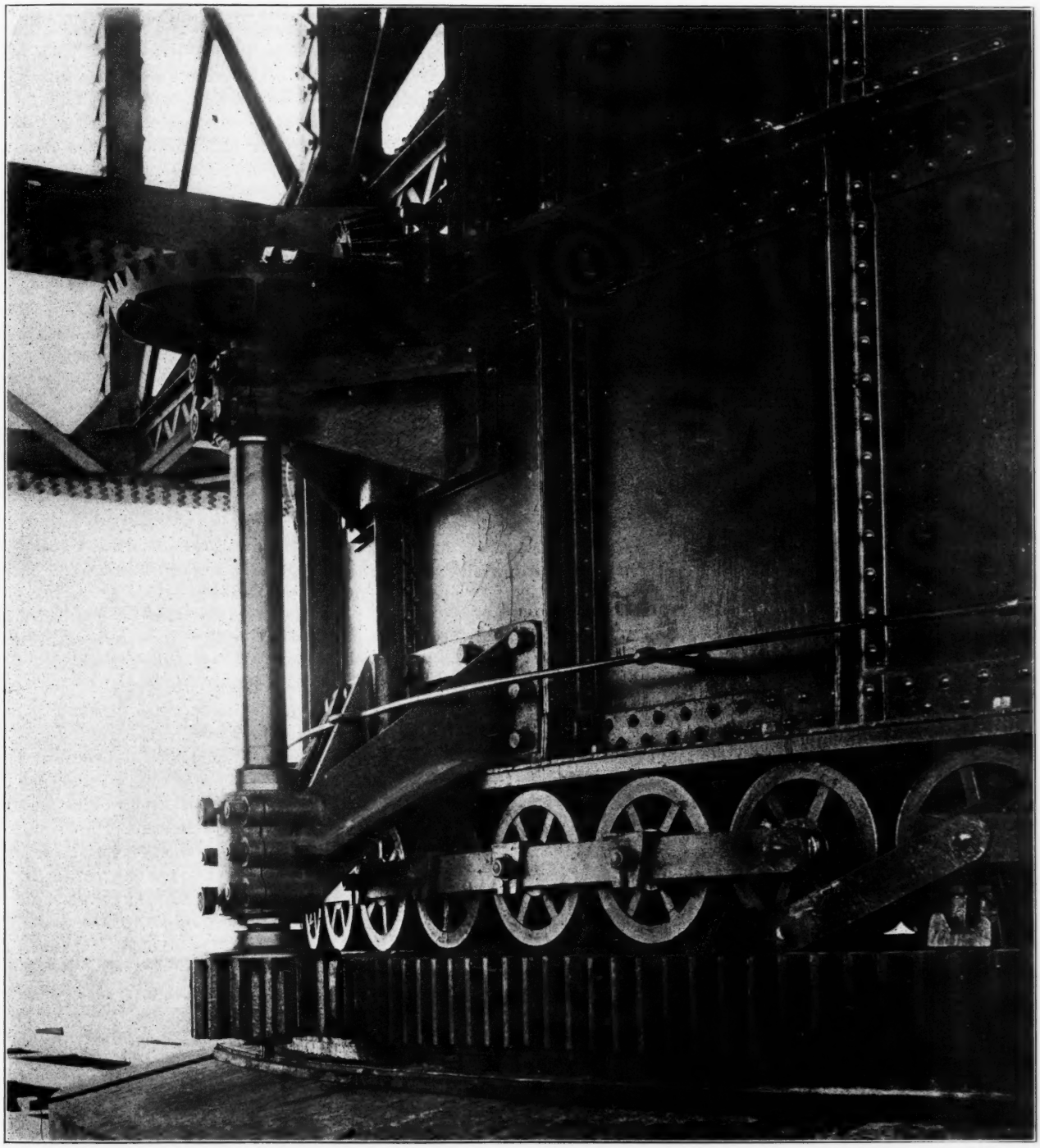


Fig. 4.—The Pivot and Moving Element of the Pyrmont Electrically Operated Swing-Bridge.

In building the Pyrmont electrically operated bridge at Sydney, in New South Wales, the sinking of a huge wrought-iron caisson, forty-two feet in diameter, was necessary. This caisson was sunk to rock bottom, sixty feet below high-water mark, the material being dredged out as the sinking proceeded until the cutting edge was finally bedded. In order to carry this huge swing-span a very substantial foundation was required. The water was pumped from the caisson and it was filled with rubble concrete, the permanent caisson extending to within one foot of low-water mark, from which point the pier consists of masonry. It is stated that the whole weight of the superstructure of the swing-span is distributed to sixteen points on a deep circular drum thirty-five feet in diameter. The V-shaped castings locking bearing nuts are seen in Fig. 4; also the drum which carries on its lower flange the upper tread. This tread bears on sixty-six cast-steel rollers, upon which the span revolves, the pivot acting in this case as a centre.

The Pyrmont bridge at Sydney is 1,200

feet long and with its approaches has a total length of 1,758 feet. It is provided with two seven-foot paths and a forty-foot carriageway which is paved with wood.

This is said to be one of the finest electrically operated drawbridges in use to-day and has a swing-span of 223 feet, allowing two seventy-foot fairways for shipping. The Pyrmont bridge has a floor space of 12,000 superficial feet. While there are many larger electrically operated drawbridges, this is said to be the first installation where one man performs all of the necessary operations from one point by electric-motor control.

There are two series-wound, fifty-horse-power motors used for slewing the bridge, through a horizontal shaft. Two vertical shafts carry pinions on their lower ends meshing with a rack around the pier. The span can be opened in half a minute but usually such quick work is not necessary although the possible quick action is of value in case of an emergency. The usual time taken is from fifty seconds to one minute.

Although one motor is of sufficient capacity to open the span there are two motors used for the operation of this bridge for sake of economy. By means of cams on transverse shafts actuated by a motor of thirty-five-horse-power capacity, the ends of the spans are raised one and one-quarter inches.

The Australian General Electric Company installed the electrical apparatus and it is stated the total cost of this work was over half a million dollars including the engineering expenses.

The electrical operation of swing-bridges is said to be very economical and it has many advantages over steam or other forms of power. The Pyrmont bridge has been opened 31,207 times without any expenditure on repairs, the current for operation being about one and one-half cents per operation of opening and closing the bridge, this including the necessary moving of end lifts and opening and closing of gates the cost of current per kilowatt being two cents.

Bids for Telephone Equipment.

The postmaster-general's department, Adelaide, South Australia, will receive bids until March 11, 1908, for supplying one common battery switchboard and 400 subscribers' telephones and 400 protectors. This is one of the most progressive commonwealths, a number of improvements, both in telephony and telegraphy, having been inaugurated in Australia, under the general direction of the Post-Office.

The Utilization of Water Power in Chili.

A communication to the *Electrician*, London, dealing with the utilization of water power in Chili, gives a brief list of the hydroelectric power systems now in operation or being installed. There is one near Lota of 750 horse-power. Valparaiso is supplied from a plant which develops 3,500 horse-power. At Santiago a 20,000-horse-power scheme is being developed, and there are various other more or less important stations under consideration.

One of the most interesting of these purposes is connected with the plan to build a railroad from Arica, on the Pacific coast, to La Paz, the capital of Bolivia, thus giving the Bolivian capital an outlet to the sea. This road will be very difficult to build, as it is carried through the Andes; and although work on the road-bed has been started, the company having this in charge has not been very successful, and a plan is on foot to transfer it to a syndicate which is also to be given authority to electrify the first section, from Arica to Tacora. The petition asking for this authority was submitted by the Chilian government to Professor Salazar, of the Chilian University. The following is a rather full and interesting abstract of his report:

The points upon which a report is required are as follows:

1. A critical opinion upon the solution of the water-power problem from a technical point of view.

2. Presuming that the necessary water power exists, a report on the cost of its development compared with steam traction from the following aspects: (*a*) working pressure; (*b*) continuity and permanence of the service in exploitation; (*c*) security; (*d*) rapidity of communication; (*e*) economy; (*f*) future extensions.

The base of the question relative to the proposed electrification is: Does there exist or not an electric railway really and truly applicable to the present case; simple and economical in operation and maintenance, effective from the point of view of every emergency of the traffic; free, in fact, from the objections to electric traction as applied to great railway lines? If these conditions are realizable, it is possible to discuss the proposed partial electrification of the Arica to La Paz railway under the various aspects of the question indicated by the director-general of public works.

At the present moment there are three systems of electric traction. In chronological order of their creation and development they are: (*a*) continuous current; (*b*) three-phase system with induction motors; (*c*) single-phase system with commutator motors.

Of these three systems, that of the continuous current (treating of long lines, and not of an urban service such as that of Santiago) can not be employed here except in combination with a high-tension polyphase transmission. From the technical point of view this system is, without doubt, satisfactory, since the continuous-current motor adapts itself to any weight or speed of train. It can not, however, be employed in cases such as that we are considering, because the installation cost is too great, as substations with rotary transformers would be necessary at various points of the track. Each of these substations would require competent management and superintendence, the result being that the exploitation of the service would be more costly and less secure than with either of the other two systems.

The three-phase system is a great advance on continuous-current system. Its adaptability to long lines has been proved by the complete success of the line from Valtellina (Italy), which has been operated electrically over sixty-seven miles since 1902. However, it presents some disadvantages, which would prevent its being applied on a line such as that from Arica to Tacora. The most serious of these disadvantages is the necessity for a double aerial conductor. The double line complicates considerably the junctions and sidings, it necessitates a double trolley, and, further, makes insulation a difficult question, as not only has the insulation to earth (rail) to be watched, but also the insulation between conductor and conductor. The three-phase motor is not ideal for railway work, since its velocity is practically constant for all loads, which complicates the construction and management of the speed regulator. Again, in this system, as in all systems of a polyphase character, a slight difference in the size of the motor wheels causes an important inequality in the power of the motors. If, for example, some wheels are older than others, certain motors will do all the work, and even be moving the others as generators. The difference in the size of the wheels exercises hardly any influence in the continuous-current system, nor in the system we will now con-

sider, and which is that proposed by the syndicate, *i. e.*, the single-phase alternating-current system, with commutator motors.

For some time past it has been recognized that the true practical solution of the problem of electric railways depends on a combination of the following:

1. Employment of the highest pressures.
2. Static instead of rotary transformers.
3. The use of a single aerial conductor.
4. Of an alternating single-phase motor, with a high power-factor and with the characteristics of a continuous motor as to its torque, efficiency and regulation.

Until recently (scarcely three years) only the first three conditions could be realized; we had not got the motor. But the problem of the single-phase railway was seriously attacked in 1900, and in 1902 the new system was tried on a scale compatible with genuine railway conditions. In the short space of time which has elapsed since then the alternating single-phase motor has demonstrated its adaptability to the most difficult cases of an electric railway both in the United States and in Europe. The characteristics of the system are:

A. Employment of the highest pressures in the feeders and in the trolley, with consequent great economy of copper. This is not possible in the continuous system, and only to a limited extent in the three-phase.

B. The reduction of the high tension (33,000 to 6,600 volts in the present case) is effected in the same way as in every alternating system, by reliable and automatic static transformers of high efficiency. Thus the employment of rotary converters, the disadvantageous principles of which have already been pointed out, is superseded. In this respect, then, the single-phase system is equal in efficiency to the three-phase and superior to the continuous.

C. The employment of a single aerial conductor. In this it is equal to the continuous and superior to the three-phase.

D. Simple, effective and economical regulation of speed. This operation is less satisfactorily realized from every point of view by the other two systems. In the single-phase the speed of the motors is not regulated by the interposition of dead resistances, which waste a great deal of energy, but by varying the number of turns of the secondary of the transformer, which is in circuit with the motor, just as the driver of a steam locomotive, by moving the lever, opens as he pleases the admission valve.

There is no doubt that at present the problem of the electrification of railways without regard to distance or the exigencies of the service has been solved in a brilliant manner by this system. The technical press is unanimous in this respect.

The commercial development of the single-phase electric railway has begun at the precise moment when the supreme government has to decide (with regard to the section from the coast to Tacora in the Arica to La Paz railway) the question as to whether it should be worked by steam, by rack, or electrically with adhesion motors, or according to the single-phase system.

COMPARISON BETWEEN THE TWO SYSTEMS OF TRACTION PROPOSED.

Taking the solution proposed by the syndicate as practical, from a technical point of view, it is necessary to discuss its different aspects as compared with steam traction.

Power—The basis of this calculation is the value of the power station indicated in the proposal to be installed at Kilometre 88. In its petition to the minister of industry and public works the syndicate proposed to install at Paluni three generators of 750 kilowatts each, with a fourth generator of the same power with its corresponding hydraulic motor as a reserve. There would be besides this a small duplicate independent plant of fifty-five kilowatts for the excitation of the alternators and the lighting of the central station. Therefore, there are $3 \times 750 = 2{,}250$ kilowatts available as total power. Adding the fifty-five kilowatts referred to, we have approximately 2,300 kilowatts.

We can assume at full load a combined efficiency of seventy-five per cent for the alternators and the Pelton-Francis waterwheels, which is the experience in practice.

Then the power of the waterfall ought to be $\frac{2{,}300}{0.75} = 3{,}060$ kilowatts, which is equivalent to 4,000 horse-power.

It is stated in the petition that, according to the calculations of Mr. Harding, the power available in the River Lluta is 70,000 horse-power. Even supposing that there is an error of a cipher, and that the available power is only 7,000, the minimum permanent hydraulic power is almost double what is required for the general installation, without taking extensions into account. It is necessary to calculate how much of the 2,250 kilowatts of the three alternators, working at one time with full normal charge, would be utilized in operating the railway service, having in view the series of losses inherent in this system.

Gross power in kilowatts = 2,250.

Efficiency (E_1) of step-up transformers = 98 per cent.

Average efficiency (E_2) of the high-tension lines = 95 per cent.

Efficiency (E_3) of the reduction transformers = 98 per cent.

Average efficiency (E_4) of the transformers of the locomotive = 96 per cent.

Average efficiency (E_5) of the motors taking into account the gearing and general friction up to the wheels = 76 per cent.

The losses in the trolley wire may be taken to be included in E_3 and E_4.

The foregoing gives us an available power of $P_u = 2{,}250 \times 0.67 =$ kilowatts. Thus the final efficiency can be estimated, at the most, as sixty-seven per cent when the installation is working at full load.

In the note under the heading of "Electrification" handed in by the syndicate, as a complement to the data furnished to the minister under date October 11, it is stated that an efficiency of eighty per cent is expected. This we consider optimistic, and, as will be seen by the preceding study, not possible.

COMPARISON OF THIS RESULT WITH THAT OF STEAM POWER.

In the petition it is stated that all the locomotives will be identical. They are to weigh approximately thirty-six tons each and to be of 240 horse-power to 320 horse-power—that is to say, of 180 kilowatts to 240 kilowatts. Deducting from the 1,500 kilowatts to be utilized on the road between Arica and Tacora the 300 kilowatts which will be absorbed by the different local services in the Arica station, there remains an effective power for traction of 1,200 kilowatts—that is to say, five locomotives working simultaneously at their maximum of 240 kilowatts each, or, instead, a greater number of locomotives with a less power.

According to Davis's tables, on gradients of six per cent, and for a speed of 7.5 miles, an effective power of three horse-power is required (or 2.25 kilowatts) per ton. It is therefore evident that a single electric locomotive of the maximum power indicated will not draw, over a six per cent gradient, at a speed of twelve kilometres, the 150 tons net represented by the steam service. It will be necessary to use two coupled locomo-

tives to do the same work as the steam locomotive which has been scheduled in the estimate for steam power.

According, again, to Davis, to draw 150 tons over a dry rail on a gradient of six per cent, a locomotive weight of sixty-four tons would be required. This again shows that for such a service two coupled locomotives would be required.

The electric power available would thus be equivalent to steam traction in the initial stages of the exploitation of the railway, supposing that at the same moment there were traveling from Arica to Tacora three trains with steam locomotives developing together 1,600 effective horse-power.

In the proposal before the supreme government of Chili it is stated that an electric locomotive can draw a goods train loaded to 140 tons net over a six per cent gradient at the rate of 6.2 miles per hour, and that a steam locomotive could draw a train loaded to 150 tons net over the same gradient at the rate of 7.5 miles an hour. As with the increase of electric power analyzed above it is possible to obtain the same speed with two electric locomotives, it would be convenient so to arrange with the contractors should the supreme government decide to adopt electrification.

To resume the argument on this first aspect of the question, electric traction according to the last modified proposal of the syndicate can be accepted as equal to the calculated steam power to be used in the initial exploiting of the railway.

CONTINUITY AND PERMANENCE OF THE SERVICE IN EXPLOITATION.

This question must be treated generally, and also with reference to the special local circumstances, the nature of the service, etc., matters which can modify in one sense or another the conclusions established for the first case.

The continuity and permanence of the service on an electric railway operated by water power is necessarily subordinate to the conditions of material security which characterize the entire hydroelectric system, both as a whole and in detail. Along with these conditions there should be a capable permanent technical board, and, it may be unnecessary to add, a vigilant and far-seeing administration. There is sufficient experience accumulated in other countries to prove that the hydroelectrification of railways has given, and is giving, entirely satisfactory results in this respect. For example, in Italy, which is not cited as a model in the matter of railways, two comparatively long lines in mountainous districts between Varese and Milan were electrified four years ago, with a result that confirms this statement.

It is worth noting, in passing, that in both these cases electrification was decided upon as a result of the reports of engineers who were commissioned to inquire whether it was convenient or not to substitute electric traction for steam. One of these lines, that of Valtellina, which I have already referred to, is exclusively hydroelectric.

In a recent investigation ordered by the directors of the Erie Railroad Company (United States) (a railway actually in course of electrification), the investigating engineer reported that the Valtellina Railway, after three years of electric working, not only maintained perfect continuity in the service, but demonstrated its capacity to deal with every class of heavy and complicated traffic which could be dealt with by steam power.

It should be noted that in the case quoted the system employed is three-phase with double-trolley aerial conductor, a system decidedly less simple and less easily managed as a whole than the modern single-phase system proposed as an alternative to steam for the line from Arica to Tacora.

The stability of hydroelectric installations, with their transmission lines, when well designed and constructed, has been demonstrated by the slight damage suffered by the Valparaiso installation as a result of the earthquake of August 16 last.

With regard to any special circumstances that might enter as factors against the proposed electrification, we know of no others than those which have been put before the supreme government. The following extracts from this document should be mentioned:

"The route which the railway must traverse in the Lluta valley is very varied; the river has acute deviations, the hills are abrupt, at times almost vertical, and, while their summits rise to heights of 1,500 metres, their bases present constant natural changes of formation, besides which there are thousands of points where there are frequent land-slips, which makes the selection of the line very difficult." "Along a distance of thirty miles the construction of the line will be very difficult, and will be exposed during its exploitation to accidents from land-slips, from falling rock, and from the inroad of the waters of the river." Finally, mention is made of the intense cold of fifteen to twenty degrees below zero in the night, even in summer. This may cause breakage of the electric conductors, with consequent interruption of traffic.

It is to be supposed (continues Professor Salazar) that these circumstances, of a purely local character, have been taken into account by the engineers of the syndicate and of the Westinghouse company in the preparation of the electrification proposal. In that case we may say that if good work, good technical direction and good administration are combined, there is no reason to fear the continuity and permanence of the service in exploitation.

SECURITY.

Under this head we must consider the comparative guarantee between an electric and a steam system with respect to accident which can occur in the service. It is unquestionable that the most serious danger will be due to the steep and prolonged gradient across a deep and tortuous valley on a considerable portion of the line. In equal circumstances electric traction is more secure than steam traction, since, besides the most efficient system of brakes that can be used in steam traction, there will be the powerful resource of electric braking. If the function of this latter is of the greatest importance from an economic point of view in the descents, it is not less important as a preventative of accidents. For this purpose it is necessary that the staff of the train be familiar with its use, and not consider it merely as an emergency brake.

It has recently been proved in Halifax (England) that electric cars running at the rate of thirty miles per hour down a gradient of four and one-half per cent can be brought to a standstill within a distance of about 350 feet in thirteen seconds after the exclusive application of the electric brake.

With regard to the dangers peculiar to an electric line such as that from Arica to Tacora they can be considered as unimportant, judging by experience elsewhere. There are already electric railways in exploitation on the single-phase system in Italy, Austria, Germany, Switzerland, France, Sweden, Belgium and in North America. The pressures employed in the trolley wire are up to 3,000, 6,000, 10,000 and 15,000 volts. In Sweden a pressure of 20,000 volts has just been tried. In no case has danger either to the railway staff or to the public been experienced.

RAPIDITY OF COMMUNICATION.

Itinerary—From the beginning the

comparison in this respect is in favor of electricity. Steam engineers have insisted in every case that electric traction is more costly, at least when water power has not been employed, or when electrification is proposed in countries where the fuel necessary for steam locomotives is cheap. But they have not been able to deny that the electric system is necessarily superior in respect to conveniences of traffic and for many other reasons. In this connection it is sufficient to bear in mind the following qualities characteristic of electric traction in general: diminution of loss in time in stopping and starting of trains; saving of the time necessary to the intake of water and coal; velocity, independent of the ability of firemen to keep up steam pressure, principally in ascending gradients; facility in varying the size of trains that these may correspond with the necessities of the service, thus avoiding useless work, etc. Such is the flexibility of the electric system that the ability to move rolling stock with equal power is much greater than with steam power. Even in England, the country of cheap coal, electrification is being adopted in many cases, not so much for economy in the traction of trains as for the other advantages already pointed out, with their consequent improvement in the itinerary. It is superfluous to add, with regard to the present report, that the conclusion favorable to the electrification of the line from Arica to Tacora presumes that the conditions stipulated as to technical direction and management are to be satisfactorily fulfilled.

As a last reflection under this heading: It would not be prudent to establish steam and afterward electrify, and it would be unwise to work both systems at the same time, as the electric system would not then be properly developed.

ECONOMY OF EXPLOITATION.

The contracting syndicate in its estimate approximates the yearly saving by the adoption of electrification on the section from Arica to Tacora at $190,000. In the last petition to the minister of industry this result is modified still more favorably. "Mr. Harding," says the syndicate, "calculates that the annual saving to the government by electrification will reach $300,000, that is to say, the increased cost of carrying out the installation would be redeemed in about three years."

To verify this calculation without entering into details of slight importance it will be sufficient to analyze the following items: (1) cost of electric energy; (2) cost of fuel.

The determining factor of cost per kilowatt-hour in an electric installation is the "load-factor." This factor, in the present case, will be fifty per cent or a little less, a very favorable factor according to our present experience. The syndicate calculates that the traffic of the five daily trains, of more or less than 950 tons each, would absorb energy from 14,000 to 15,000 kilowatt-hours. Adding to this the consumption in Arica, with the 300 kilowatts set aside for this station, we arrive at a consumption of 18,000 kilowatt-hours per day, or the half of the 100 per cent represented by the product $24 \times 1{,}500 = 36{,}000$ kilowatt-hours, presuming twenty-four hours working per day.

Now, for a hydroelectric installation of 2,250 kilowatts in the primary station, and with the favorable load-factor of fifty per cent of the total useful energy produced, an estimated cost per kilowatt-hour of 0.36 to 0.72 cent might be taken as reasonable under ordinary circumstances. But, treating of an installation so far removed from the centres of industry, and with obligations so serious as that of an international railway, it is wiser to make allowance for an ample technical staff, for depreciation, etc. We would add twenty-five per cent to this price and raise the estimated cost per unit to 0.54 cent. The syndicate estimates that eighty per cent of the current can be delivered at the rails, which is not in accordance with our estimate of sixty-six per cent after a careful allowance for the inevitable losses in the system.

Taking the last figure, the resulting cost per unit used would be 0.8 cent, that is to say, fifty per cent greater than the cost per unit fixed by the syndicate, by which the total annual cost of the energy consumed is estimated at $23,000. According, therefore, to our calculation, the total annual cost will be $34,500. The difference between the estimates amounts to $11,500, and but slightly affects the total saving of $300,000 estimated by Mr. Harding. This conclusion is very important, as it shows that even after doubling the estimated cost of the production of energy the exploitation of the railway would be much cheaper by electricity than by steam.

In the syndicate's note on "Electrification" the basis of calculation for the cost of coal in a steam system is taken at 0.544 kilogramme per ton-kilometre. The daily traffic is estimated at 154,000 ton-kilometres. Thus in 300 working days, and at the rate of 0.544 kilogramme per unit, the annual consumption of coal would be 25,000 tons for up trains. Adding to this the small consumption for the trains coming down the gradient, Mr. Harding arrives at the grand total of 25,950 tons. At $8.12 per ton delivered in Arica this consumption represents a cost of $215,000. Beyond this figure the cost of carrying the coal is taken as 3.6 cents per ton per kilometre over eighty-one kilometres, making a total of $76,000. In this way the syndicate fixes the cost of coal alone with a steam system at $286,000.

We consider this calculation somewhat excessive, for the following reasons: The effective consumption (not calculated) on the Tabon section between Santiago and Valparaiso on a gradient of two and one-quarter per cent and with an average speed superior to that fixed for the Arica to Tacora line is approximately as follows per train-kilometre: Express trains, twenty-six kilogrammes; ordinary trains, thirty kilogrammes; goods trains, thirty-three kilogrammes. The weight of these trains varies from 250 to 300 tons. Taking the most unfavorable case (thirty-three kilogrammes per twenty-five tons), the average consumption of coal (principally Australian, which would be the same as that which would be used on the La Paz Railway) is only 0.132 kilogramme per ton-kilometre. Would, therefore, the calculation of 0.544 kilogramme (four times greater) be justified simply on account of a gradient one-half greater and with a narrow gauge and rack? If so, the case is still stronger for electricity.

In the meantime, however, we will adopt a basis of calculation only three times greater, *i. e.*, 0.396 kilogramme instead of 0.594 kilogramme. Thus the 25,950 tons annually are reduced to less than 19,000, and the final item of $286,000 to only $209,000, or a difference of $77,000. As the calculated difference in the cost of electric energy is $11,500, the sum of these two items must be subtracted from the $285,000, which makes up the $300,000 estimated by Mr. Harding as the amount to be saved by electrification. After this deduction there is still a balance in favor of electrification of $199,000, and this is that given in the original estimate of the syndicate at the beginning of 1907.

It is further pointed out, in the syndicate's later proposal, that the results of the following items of comparison have not been taken into account: (*a*) Necessity for two firemen in the rack locomo-

tives; (*b*) cleaning of the boilers, furnaces, etc.; (*c*) saving of fuel in the workshops. To this we would add the difference in expenditure on maintenance of the permanent way, which is much less with electricity than with steam.

As an illustration, we will make a comparison respecting the cost per ton-kilometre calculated for this line and the actual cost of the railway of Valtellina. In the present case thirty millions of ton-kilometres are to be dealt with annually at a cost which, for reasons previously given, we will raise from $64,000 to $72,000; the result is 0.61 cent Chilian gold per ton-kilometre. In the case of Valtellina the cost of hydroelectric exploitation, after the first year in which the line was taken over by the Italian government, was only 0.34 cent per ton-kilometre.

If the medium gradient in the Arica-Tacora line is necessarily many times greater, the difference in the calculated cost leaves an ample margin.

Future Extensions—These will be easily carried out without interruption to the traffic, and will be less costly per unit than in the primary installation. In fact, this includes the entire trolley line with steel suspension, which is supposed to be double according to recent practice. As the copper conductor, for mechanical reasons, must have a minimum section of 2,000 mils to 2,500 mils, there is sufficient margin for increasing the current and pressure to double, if this were necessary for future extensions. From this it can be deduced that these extensions would be limited to the following: (1) The hydroelectric plant to an extent equal to or greater than the first installation. (2) The number of high-tension feeders and the corresponding substations with static transformers. There would be no necessity to change the trolley line.

The cost per kilowatt for the effective pressure calculated above at 1,500 kilowatts is a little more than $500. Limiting the extensions to the parts of the installation indicated, the cost per useful kilowatt added would be much less than this sum.

Résumé and Conclusions—The present report deals primarily with electrification from a technical point of view, presuming the exactness of the data given as a basis for the proposal; secondly, with regard to the comparative results of steam and electric traction under their different aspects, as referred to by the director of public works. From this double study the following conclusions, sufficient to form a decision, can be deduced:

1. The electrification of the railway from Arica to La Paz in the section from Arica to Tacora (100 miles) is technically and economically realizable with the single-phase system, which is that proposed by the syndicate of public works.

2. The annual economy resulting from the electrification can be taken as not less than $200,000, as calculated in the first place by Mr. Harding.

3. The realization of this economy, the continuity and permanence of the service, as well as the security and punctuality of the traffic, necessitate the following conditions: (*a*) A complete and well-executed installation. (*b*) Ample and well-selected technical staff. (*c*) A vigilant and far-sighted administration.

Unless these conditions can be permanently maintained, electrification would not be advisable, as the expectations which justify its adoption would not otherwise be realized.

The Tenth Anniversary Celebration of the Merchants' Association of New York.

The Merchants' Association of New York celebrated its tenth anniversary on Thursday, November 14. There was a meeting and reception for its members and their guests, and a buffet luncheon. The presiding officer of the meeting was Clarence Whitman, who has been president of the association since 1903.

One of the principal speakers was George Bruce Cortelyou, secretary of the Treasury. In the course of his address, Mr. Cortelyou spoke as follows:

"We have learned some things by experience recently, by a very trying experience for many of you, but one from which I hope you are even now rapidly recovering. Experience is of value only as we profit by it. Let us hope, then, that in what we have just been through we have all had that kind of experience. Among other things we have learned what it means to stand steady in times of storm and stress. We have learned, too, more fully perhaps than heretofore, the value of credit in the business world, and have had brought home to us anew the fact that it is a most delicate part of a most delicate mechanism. We have learned where weak places were, where improper practices obtained; we have learned again the value of cooperation.

"In some directions what was weak has been strengthened; and, what is all-important, if any man has been guilty of a violation of trust that makes him amenable to the law, we may feel confident that its processes, in orderly manner, regardless of sensational incitement for or against him, will be evoked in the interest of the public.

"The financial institutions of this great city have had, during the past three weeks, one of the severest tests that they have ever undergone; and when the people of the country realize, as those of us who are familiar with the conditions realize, what they have done to stay panic and reestablish confidence, the measure of public approval of their service will be large indeed. Other great commercial and industrial centres have cooperated, and back of them all has stood the government as representing all the people, seeking to aid only legitimate interests and to render assistance to every state and every section.

"It is a time when every citizen should assume his share of the burden. The hoarding of money, the exaction of unnecessarily harsh requirements in business dealings, but retard our return to normal conditions. The hoarded money should be put back in the banks, and the exactions of bankers and merchants should be proportioned only to actual business necessities. To do otherwise is not only unpatriotic, but unwise. I believe that if this money of the country, wherever hoarded, were at once put back to fulfil its functions in the channels of trade, there would be, within twenty-four hours, an almost complete resumption of business operations. I doubt whether we can in any way estimate the loss that has fallen upon those who have, either from selfish or misguided motives, thus drawn their money from places of more than reasonable safety to put it where it has been lost through robbery or fire or other misfortune.

"During periods of anxiety and unrest the President and his advisers are appealed to from all quarters with suggested remedies for existing evils. Some are worthy of serious consideration, but many—very many—do not fall within that classification. A case in point is the suggestions of various kinds that are now made for currency reform. The subject is one of great concern to every citizen, and it must have the fullest and most careful consideration. we must not be hurried into ill-considered legislation. Panic in legislation is worse even than panic in business, for it strikes at the foundation of government."

The Faraday Society.

The thirty-first ordinary meeting of the Faraday Society was held on Tuesday, October 29, at the Institution of Electrical Engineers, 92 Victoria street, S.W., London, England. N. T. M. Wilsmore, M.Sc., was in the chair.

The chairman announced that Sir Oliver Lodge had accepted the invitation of the council to succeed the late Sir William Perkin as president of the society.

A paper on "The Electrolysis of Salt Solutions in Liquefied Sulphur Dioxide at Low Temperatures," communicated by Dr. Bertram D. Steele, was read in abstract by the secretary.

This is a preliminary account of the results at present arrived at in the course of a general study of the electrolysis of salts in liquefied gases. The present paper deals with the case of a solution of potassium iodide in sulphur dioxide. Electrodes of various materials were used, and the changes at anode and cathode were carefully studied. With platinum or mercury cathodes a very rapid diminution of current (depending on the initial current density) due, in the author's opinion, to a film of sulphur, was observed. Potassium sulphite with an admixture of sulphur was after continued electrolysis found to be deposited on these cathodes. Using silver, copper, or iron cathodes of large area, a constant current was maintained, the sulphides being formed in these cases. Iodine was formed at the anode, being either liberated or found in combination, depending on the metal employed. No potassium as metal was found to be deposited on the cathode.

The author concludes that sulphur cations exist in the solution.

Measurements of conductivity and ionic velocities have also been made, and the results obtained will be published in due course.

Dr. T. M. Lowry was skeptical as to the existence of sulphur ions. He thought secondary reactions would explain Dr. Steele's observations.

A paper by F. E. Weston, B.Sc., and H. Russell Ellis, B.Sc., on "The Action of Aluminum Powder on Silica and Boric Anhydride," was read in abstract by Mr. Weston, who showed, on a small scale, some of the reductions described.

The authors have studied the action of aluminum powder upon boric anhydride and silica respectively. It is shown that in the case of boric anhydride the reducing action of the aluminum depends upon the fineness of both the aluminum and the boric anhydride. *Eg.:*

(*a*) Mixtures in molecular proportions of the finest obtainable aluminum powder and powdered B_2O_3 that has passed through a sieve of 14,400 meshes to the square inch react at once, in the cold, when started with a fuse of Mg ribbon and BaO_2 powder.

(*b*) Mixtures in proportion of Al_2 to $2B_2O_3$ only react when heated to dull redness in a muffle furnace.

(*c*) Similar mixtures to (*a*) and (*b*), but using B_2O_3 that has only passed through a sieve of 3,600 meshes to the square inch, only react when heated to 300 degrees centigrade and dull redness respectively.

The products of the reaction were shown to be Al_2O_3 and mixtures of boron with aluminum borides, the latter predominating in the mixture containing molecular proportions and the former in the other mixture.

In the action of aluminum upon silica the authors used for the latter kieselguhr, precipitated silica, and fine silver sand. Here again the action took place more readily with the finer varieties of silica, the speed and energy of the reaction being in the order—precipitated silica, kieselguhr, silver sand.

The action took place in the cold with precipitated silica and kieselguhr on being started with a fuse of Mg and BaO_2, when the constituents in the mixture were in the ratio of $3SiO_2$ to 8Al; when the mixture contained the constituents in the ratio of $3SiO_2$ to 4Al the reaction only took place on heating the mixture to dull redness. When sand was used the mixture had to be heated to a dull redness in each case before the action commenced, and in the mixture containing $3SiO_2$ to 4Al free sand and free Al were found in the product.

The products of the reaction contained in all cases Al_2O_3, silicon (as shown by the production of $SiCl_4$), and probably some silicides of Al.

Dr. R. Seligman suggested that some of the heat required in these reactions was furnished by the aluminum or boron, as the case may be, burning in the air. The fireproof slags obtained in many cases were being used for making acid-resisting crucibles and for other industrial purposes.

Dr. F. M. Perkin pointed out that the difficulty of getting a fusible slag in all cases prevented the preparation in a pure state of products like boron and silicon.

Dr. F. M. Perkin and L. Pratt read a paper on "The Reduction of Metallic Oxides with Calcium Hydride," and illustrated some of the reductions.

When copper oxide is mixed with calcium hydride in proportions corresponding to $2CuO + CaH_2 = 2Cu + CaO + H_2O$, and ignited by means of a match, a vigorous reaction ensues, and volumes of steam are given off. On cooling a black mass is obtained, which on treatment disintegrates, owing to solution of calcium oxide, and metallic copper in a state of fine division is obtained. Pyrolusite, hæmatite, and tin stone all behave in a similar manner. Zinc oxide appears not to be reduced. Lead sulphide and antimony sulphide both react vigorously, and during the reaction the mixture swells up considerably, rising up out of the crucible in a cylindrical form. Very little metal is produced, the bulk of the product being a dark gray mass, which appears to be a compound of the metal with calcium and sulphur.

Borax and boric anhydride also react with calcium hydride when the mixture is strongly heated in a muffle furnace. Silica in the form of fine sand only reacts after prolonged heating, but reaction takes place more readily when kieselguhr is employed. Wolframite and rutile only react with difficulty.

Experiments were also tried with metallic calcium and wolframite. In this case a particularly vigorous reaction takes place, the tungsten being melted and being obtained on cooling as a hard regulus. The heat is so great that the calcium oxide is also melted. Rutile is also reduced by calcium; the reaction, however, is not so intense, and the titanium and calcium oxide are not fused.

The action of metallic calcium upon metallic chlorides was also studied. Manganese chloride and cadmium chloride are readily reduced. When metallic calcium and strontium chloride are mixed together in molecular proportions and ignited by heating in an iron crucible by means of the blowpipe reaction ensues—

$$SrCl_2 + Ca = CaCl_2 + Sr.$$

Very little metal, however, is obtained, probably owing to the formation of a subchloride, ClSr — CaCl. On adding two atoms of calcium the reaction is intensely vigorous, and the metal is obtained as a fused regulus. With barium chloride the reaction is less vigorous. With the alkali metals very vigorous reactions also take place.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on December 3 for the following electrical supplies: One electrically driven ambulance for delivery at the Naval Medical School Hospital, Washington, D. C.; twenty water-tight annunciators, 71,600 feet electrical cable, 6,500 feet interior cable, miscellaneous electrical supplies, 4,000 miscellaneous fuses and 30,750 feet lighting and rubber-covered wire for delivery at New York city; 125 eight-way distribution and feeder junction boxes, 17,000 feet steel enameled conduit, seventy-four desk and bracket fans with spare parts, twelve portable ventilating sets, 12,500 feet single and twin-conductor wire, and 26,800 miscellaneous fuses for delivery at League Island, Pa.; 1,500 feet copper cable and one 220-volt, semi-enclosed motor for delivery at Washington, D. C.; four generators with spare parts and one fifteen-horse-power, semi-enclosed motor for delivery at Boston, Mass.; one 125-volt generating set and 5,000 feet single and twin-conductor wire for delivery at Portsmouth, N. H.; one one-horse-power electric motor for delivery at Pensacola, Fla.

The bureau will open bids on December 17 for the following electrical supplies: 4,800 feet conduit, 250 thirty-two-candle-power lamps, 4,800 feet rubber-covered wire and three switchboard cabinets for delivery at Puget Sound, Wash.; 500 Leyden jars and twenty sets of receiving points with glass jackets for delivery at Mare Island, Cal.

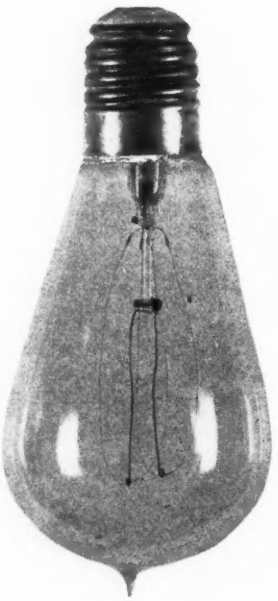
A Corporation with a Soul.

In the November issue of the *West Coast Magazine*, published at Los Angeles, Cal., John S. McGroarty has written a very interesting story entitled "A Corporation with a Soul." This deals with the spirit of affection and cooperation which obtains throughout the entire organization of the Edison Electric Company, of Los Angeles, Cal. The beginnings of this company were the humblest, and its growth has been marvelous. From its inception to the present hour its history is a history of men. The author knows of no institution the wide world over that has shown, with greater emphasis, what men can do, the wonders they can perform, and the obstacles that they can overcome.

The early work of H. H. Sinclair, the pioneer in electrical development in the Redlands of California, is described, and a tribute is paid to John B. Miller, president of the company. The creed conceived by S. M. Kennedy, general agent of the company, is rehearsed, and a sketch of the Ten-Year Club, an organization open to every man who has been in the employ of the company for that period of time, is given.

A New Filament for Incandescent Lamps.

Among the patents which have been issued recently are two bearing on the manufacture of an incandescent filament and process, issued to Eugene McOuat and Henry W. F. Lorenz. These were issued



"Zenith" Incandescent Lamp.

on October 22, and are numbered, respectively, 869,012 and 869,013. The invention relates principally to the manufacture of filaments and glowers such as are used in incandescent electric lamps, the object of the invention being to produce a filament having high efficiency and a long period of usefulness.

In preparing the filament according to this invention, a core such as a carbon filament is selected, this being coated with a mixture of silicon and metal or metals. This coating is applied preferably by preparing a caramel solution carrying a mixture of silicon and metal in mechanical suspension. In this solution the carbon filaments are dipped in such a way as to take on a coat of the prepared material. The filaments are then baked so that the coat becomes dry and incorporated with the filament. The baking preferably takes place in an indifferent gas, and the temperature is raised to a point sufficiently high to bring about a reaction between the silicon and the metal. In this way a silicide-coated filament results.

The silicide may be incorporated with the filament by other processes such as the collodion process. This general process consists in dissolving cellulose, such as cotton, in nitric acid, hydrochloric acid or zinc chloride, and the plastic solution obtained is then forced through a die, hardened with alcohol, and afterward carbonized. According to this invention, while the mass is in a plastic state there is mixed with it a quantity of silicon and a metal, both in a finely divided state. All of the metals that have a high melting point, except those of the platinum group, may be used.

The silicide filament may also be made by an impregnation process, in which the entire core of the filament is impregnated with the silicide. In this instance a carbonizable thread is soaked in a mixture containing silicon and a metal, and afterward carbonized and the silicon converted into a silicide by a high temperature.

Instead of using silicon and a metal in the process, which involves the use of a caramel solution, the silicide may be used directly, in which case a caramel solution is made in which a quantity of silicide is mixed. The silicide is then deposited directly upon the carbon cores by dipping them in the mixture. The filaments are afterward baked in the usual manner to harden the coat and carbonize the caramel solution with the silicide on the carbon core; or the filament of carbon can be flashed in a mixture of a volatile silicon and volatile metal compound, thus depositing silicon and metal simultaneously upon the carbon core. At a high temperature the silicon and carbon unite to form a silicide coat.

An illustration of an incandescent lamp which has been produced, utilizing this filament, is shown herewith. This lamp has been designated by the inventors as the "Zenith" incandescent lamp. It is stated that lamps equipped with filaments made by this process have burned for 400 hours at an efficiency of 1.8 watts per candle, with an output of twenty candle-power. It is expected to do even better than this in the near future.

The Marconi wireless telegraph station at Siasconset, Mass., was destroyed by fire on the morning of Friday, November 15. This station was the first to be established on this coast for commercial business.

The Early Development of the Edison Incandescent System.

A meeting of the New York section of the Illuminating Engineering Society was held at the Engineering Societies Building, Friday evening, November 14, to listen to an illustrated lecture by W. S. Andrews, of Schenectady, N. Y., on the early development of the Edison incandescent lighting system. Before starting his lecture, Mr. Andrews said that the announcement that the lecture would be on "Pioneer Electric Lighting" was too broad for his topic, as he intended to confine himself to his personal experiences, which were entirely limited to work with Edison. For this reason, reference to the early work of others would not be made.

Mr. Andrews then sketched briefly Edison's work between 1880 and 1890, and showed, by means of lantern slides, much of what had been accomplished. He explained some of the early difficulties which had been encountered, such as that of insulating the first underground conductor. In the first attempt to distribute current in this way, bare wire had been used—of course, with failure. The final insulation, which had been used satisfactorily for about three months, was obtained by winding soft rope around the wire, and then coating this with tar. A photograph was shown of the old Edison laboratory at Menlo Park, N. J., which was lighted in this way by lamps placed on posts. Two or three of the earlier types of lamps were also shown, some of these having peculiar forms, and the interiors of the various factories at which the work was done were illustrated.

Mr. Andrews dealt briefly with the progress in developing the system, and showed photographs of those early stations, which were notable for various reasons, each being, generally, the first at which a noteworthy advance in the art was made. Mr. Andrews also related a number of interesting personal experiences and anecdotes of Edison.

The meeting was rather noteworthy, as there were present nearly a dozen men who had been associated with Edison in this development. The first of these called upon was T. C. Martin, of New York, who told briefly of his connection with Edison from 1877 to 1879. To indicate how great had been the development of the electric lighting industry since it was first started, he stated that, according to the statistics of the United States Department of Commerce and Labor, the capital to-day invested in the art is close to a thousand million dollars.

The interesting attempt to drive a dynamo by the first 100-horse-power, direct-connected, high-speed engine, to which reference had been made by Mr. Andrews, was explained more fully by C. L. Clarke. This was a Porter-Allen engine designed to run at 600 revolutions a minute. When started and gradually brought up to speed by Mr. Porter, it made so much noise that all but three of the spectators left the room. As it was Mr. Porter's engine, he was obliged to start the engine and to see the test out. Edison naturally would show no timidity, and Mr. Clarke said that he himself was too young to know the risk. The engine, however, was brought up to 750 revolutions, but after running for a short time it was decided that it was not safe. The plans were therefore changed, and an engine of the same output, but running at 350 revolutions a minute, was attached to the dynamo.

The next speaker was J. W. Lieb, Jr., who had started out under Mr. Andrews. He gave briefly some of his experiences in developing the system in this country and its introduction into Italy, and called attention to the fact that the system, as then used, was essentially that employed to-day, and that its inventor should be given credit for the development of a complete system.

Some interesting experiences connected with the installation of the first Edison station in South America were related by Mr. Stewart, who also said that the old unit installed at the Holborn Viaduct station, in London, in 1882, was still in operation last summer. W. S. Howell related his experiences as manager of the New Brunswick (N. J.) station, and showed how he had secured good results with the lamps by taking great pains in maintaining good regulation. His successes had led Edison to ship him a number of new lamps, which he put through a life test. Frank J. Sprague explained how he had worked into the Edison company and later worked himself out of it by being too ambitious to develop the electric motor for power distribution. W. J. Jenks, who was also in the thick of the work, threw some light on Mr. Sprague's career by reading a letter from Edison to Mr. Andrews. On Mr. Sprague devolved the work of calculating the distributing system for all the stations, as he had developed the method, but Edison thought he was too enthusiastic in the laboratory work.

Professor W. B. Marks described the financial transactions which were required when the first 10,000-horse-power station was constructed in Philadelphia. Four hundred thousand out of the one million dollars raised for this purpose was expended before any construction was started. This was the first station which sold power at a rate per kilowatt-hour, and secured financial success in this way.

J. D. Flack and R. W. Pope also related their connection with Edison in his work, though Mr. Pope's relations were with the Edison printing telegraph system.

This closed the discussion. President C. H. Sharp then announced that the next meeting of the New York section would be held on the evening of Thursday, December 12, this being the second Thursday of the month, and that Bassett Jones, Jr., would read a paper entitled "The Relation of Architectural Principles to Illuminating Practice."

The meeting was then adjourned.

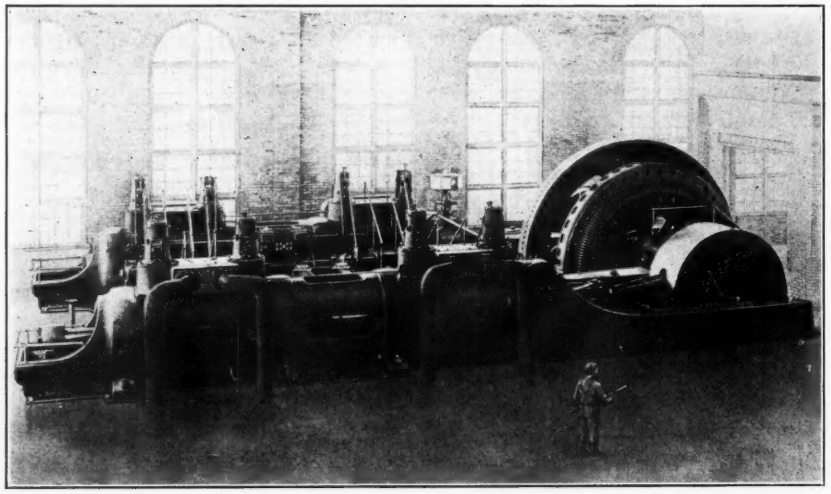
The Use of the Telephone in Target Practice.

A brief description is given by F. A. Cornell of the use of the telephone at Camp Perry, Ohio, where the national rifle match was held recently. Part of this equipment included over forty complete telephone circuits, which were operated by the signal corps of the Ohio National Guard and controlled 180 targets. On the firing line the instruments were mounted at suitable desks about twenty-five feet to the rear of the competitors, and about fifteen feet from the scoring tables. The instruments used were standard Government field sets. When a team took its position on the range, the officer in charge was continually advised of the exact state of affairs in the pit where the targets were handled by means of the field sets. At his command over the telephone, red markers which had been raised in front of the targets were removed and the first volley fired. The targets, which are arranged in pairs, were then dropped and the result telephoned to the scorers, who indicated the results of the shots on the targets at the firing line. The scorer could obtain any detailed information desired, by means of the telephone, and thus give each competitor the advantage of knowing the exact result of his shot, enabling him to make proper sight adjustment or wind allowance.—*American Telephone Journal* (*New York*), *November* 9.

Recent Installations of Allis-Chalmers Gas Engines.

Power users in practically all lines of business have shown very active interest in recent gas-engine installations. This is the natural result of the unprecedented scale upon which the United States Steel Corporation has entered upon the use of gas power.

The saving in fuel effected by use of the gas engine as a prime mover has long been fully realized by power users of this country, yet little progress has been made except in the natural gas district, chiefly because of a widespread doubt as to the reliability of engines of this type. The performance of the engines already installed by leading gas-engine manufacturers has, therefore, been watched very closely and the record of some recent installations will undoubtedly prove of interest to all power users.



ALLIS-CHALMERS FOUR-CYCLE, DOUBLE-ACTING, TWIN-TANDEM GAS ENGINE, DIRECT-CONNECTED TO 1,000-KILOWATT ALTERNATING-CURRENT GENERATOR, MILWAUKEE NORTHERN RAILWAY, PORT WASHINGTON, WIS.

The first Allis-Chalmers gas engine to be put in constant service was a tandem engine of 1,000-horse-power maximum capacity, direct-connected to an Allis-Chalmers direct-current generator of 500-kilowatt rated capacity. This unit is installed at the Milwaukee works of the Illinois Steel Company. Although it was the first gas engine built by this company, it started successfully on its first trial and after a few days devoted to the tests and adjustments natural in a first installation the engine was put in continuous day and night operation where it has remained ever since, only shutting down with the mill on Sunday.

This is a record-breaking performance, and possibly the explanation lies in the fact that the Allis-Chalmers Company, while new as a manufacturer of gas engines, is an old and experienced builder of heavy-duty steam engines, pumping engines and other lines of heavy machinery, and for this reason realized from the outset the necessity of heavy, rigid design.

As would be expected of an engine installed at a rolling mill, the load varies greatly in character and is subject to wide fluctuations. Mill motors in all classes of service and incandescent lights are carried from the same generator, but the regulation is so close that there is practically no change in voltage with changes in load even such as would be shown by flicker of the lights.

Another unit of 600 horse-power, direct-connected to a 350-kilowatt Allis-Chalmers direct-current generator, has been for some time in service at the works of the Trenton Iron Company, Trenton, N. J. This engine is supplied with gas from producers furnished by the R. D. Wood Company. The unit differs slightly in type from the one just described, and was the first of its size and type to be started by the Allis-Chalmers Company. This unit has been in continuous service ever since first started, on loads ranging from full rated capacity to fifty per cent overload.

A 2,000-horse-power Allis-Chalmers engine direct-connected to a 1,000-kilowatt generator has been for some time in operation on blast furnace gas at the plant of the National Tube Company at McKeesport, Pa.

This engine is a twin tandem or a four-cylinder engine with cylinders of the same size as those installed by the Milwaukee works of the Illinois Steel Company. It was but natural, therefore, that this engine should be put into regular service immediately on starting up and give the same satisfactory results as were obtained by the Milwaukee plant. This engine is the first of several units which the Allis-Chalmers Company is installing at the same plant. Power is used for mill motors and lights and, as is customary in the steel business, all these engines are operated on twenty-four hours' service.

Two units, duplicates of the unit at McKeesport, are just going into service at the power-house of the Milwaukee Northern Railway Company at Port Washington, Wis. This is an interurban line, with the city of Milwaukee as its southern terminal, operated exclusively by gas power. The generators are 1,000-kilowatt Allis-Chalmers, three-phase, twenty-five-cycle alternators, direct-connected to Allis-Chalmers gas engines, the gas being supplied by producers.

A duplicate of the Trenton engine, using natural gas, has also been recently put in service at the Kokomo plant of the Pittsburg Plate Glass Company. This is the first of a number of units which the Allis-Chalmers Company is building for that service.

Two units of 4,000 horse-power each, consisting of Allis-Chalmers gas engines direct-connected to 2,000-kilowatt Allis-Chalmers alternators, will very shortly be put in operation at the South Works of the Illinois Steel Company, South Chicago, Ill. These engines operate with blast furnace gas, and, as the design in all respects duplicates that of the engines already in service, there is every reason to believe that they will start up with the same characteristic absence of difficulty.

Another 4,000-horse-power unit is now in the course of erection at one of the Carnegie plants in the Pittsburg district, this unit being the first of seven 4,000-horse-power units, which are being installed at the rate of one every thirty days in the same power-house.

The performance of these first engines is being given especially close attention by the officials of the Indiana Steel Company, at whose new mills at Gary gas power is to be used exclusively.

The entire electric power equipment of this plant is being supplied by the Allis-Chalmers Company. The portion now under contract consists of seventeen Allis-Chalmers gas engines rated at 4,000 horse-power each. Fifteen of these are direct-connected to Allis-Chalmers twenty-five-cycle, three-phase alternators, which will operate in parallel and supply current to

more distant portions of the mill; two are direct-current generators supplying current for portions of the plant immediately adjacent to the power-house.

Allis-Chalmers Company is also building eight blowing engines with the same sized gas cylinders as the electrical units for the same plant, making twenty-five engines, or a total of 100,000 horse-power which the company is supplying for this power-house alone. It will require approximately 1,000 carloads to complete the shipment of these engines. The electrical power-house, in which will be installed the seventeen electrical units, is 1,000 feet long and 105 feet wide. Switchboards are arranged in the gallery located at such height that all of the units and the signals of the engine attendants may be readily observed by the operators at the switchboard.

It will be one of the largest power-houses in the world and the electrical generating station at this plant alone will be double the size of any previous gas-engine installation either at home or abroad.

The power-house containing the Allis-Chalmers blowing engine units is of the same width as the electrical house and 600 feet long. These figures give some idea of the magnitude of this gas-engine installation and of the confidence which the designers of this great plant repose in the Allis-Chalmers gas engine as a prime mover.

Benjamin Wireless Cluster Patent Sustained.

On Friday, November 15, the Circuit Court of Appeals for the Second Circuit (Judges Lacombe, Cox and Ward) rendered a decision sustaining claims five and seven of the Benjamin wireless cluster patent No. 721,774, dated March 3, 1903, in the suit of the Benjamin Electric Manufacturing Company against the Dale Company and John H. Dale, involving the Dale multiple wireless cluster. The case originally came before Judge Holt of the Circuit Court, and he sustained the validity of the Benjamin patent, but he held that the Dale cluster did not infringe. The Court of Appeals, while confirming Judge Holt as to his finding of validity, reverses the lower court on the question of infringement and finds that the Benjamin patent as to claims five and seven is infringed by the Dale wireless cluster. A second suit brought by the Benjamin Electric Manufacturing Company against the Dale Company and John H. Dale concerns the series wireless cluster marketed by the Dale Company. An order has heretofore been entered in this second suit providing for an injunction and accounting as to the Dale series cluster in case the court entered an injunction and an accounting as to the multiple cluster involved in the first suit.

Good Condition of the American Telephone and Telegraph Company.

Theodore N. Vail, president of the American Telephone and Telegraph Company, has sent the following letter to shareholders under date of November 15:

I have received many inquiries lately in regard to the position of your company, and therefore take this opportunity to give you briefly the following facts:

Earnings—The revenue of the company is showing large net gains over the same periods of last year. These gains are increasing as the months go on. For the ten months ended October 31, 1907, the net earnings were $13,715,000, against for the same period 1906, $11,579,000. Of this period the month of October, 1907, showed net earnings of $2,567,000, against for October, 1906, $2,004,000.

The earnings of the associate companies are not only showing large increase of gross revenue, but also marked decrease in percentage of operating, even though there has been spent for maintenance $2,000,000 more this year than last. The surplus or undivided profits, of which this company's share would be several millions, shows a large increase over last year.

Second—Cash position. The company has cash in banks—over $18,000,000. Besides this it has lately acquired cash assets of several million dollars and in addition a substantial amount of the American Bell Telephone four per cent bonds, maturing July, 1908.

Third—Future needs. It will not be necessary for the company to do any financing until the requirements of 1909. The company has never been earning so much money, nor have its prospects ever been so bright as at the present time.

This is a fine showing, and is a cause for congratulation. President Vail, although taking hold only in May of this year, has made remarkable strides in increasing the utility of this great company to its patrons, and advancing its value to the shareholders.

Dr. Alexander Graham Bell's Airship Launched.

A dispatch from Baddeck, Nova Scotia, to the New York *Sun*, dated November 14, says:

"The successful launching of Dr. Alexander Graham Bell's recently completed airship took place here yesterday. It was witnessed by a small gathering of the intimate friends of the inventor. Mrs. Bell presided, and in breaking a bottle of champagne over the bow of the vessel, declared its name to be 'The Signet.'

"The giant kite was then towed out on the lake, where it was photographed, together with the inventor, his corps of assistants and the guests assembled."

The airship is built up of 3,000 unit tetrahedrons, which are so disposed as to make the ship itself one great tetrahedron which has for its base the top of the machine thirteen metres in length. The several units are covered on two of their sides with silk.

The total area of surface thus exposed is over 2,000 square feet. The motor used is of the Curtis type, four cylinders, twenty horse-power. It weighs 120 pounds, which brings the total weight of the ship up to 290 pounds. A hole is cut through the width of the airship in the middle for the accommodation of the aviator.

Owing to a snowstorm in progress at the time of launching no attempt was made to fly the machine. Indeed Dr. Bell stated in addressing his guests that he did not assume to have solved the problem of aerial flight by the construction of this first ship. He has great faith, however, in his success.

Pennsylvania Traction Merger.

A consolidation of traction properties in York, Pa., and vicinity has been effected. The name of the new company will be the York Railways Company. Letters-patent for the new company have been issued, and it will become operative at once.

The following companies will be consolidated or merged: The York Street Railway Company, Wrightsville & York Street Railway Company, The York & Dover Electric Railway Company, The York & Dallastown Railway Company, York Haven Street Railway Company, Red Lion & Windsor Street Railway Company, Hanover & York Street Railway Company.

The capital of the York Railways Company will consist of $10,000,000 first mortgage and collateral trust five per cent fifty-year gold bonds, dated December 1, 1907, and due December 1, 1957; $2,000,000 preferred stock, five per cent dividends to become cumulative three years from date of issue, and $2,500,000 common.

Of this capitalization there has been acquired by a syndicate, of which Brown Brothers & Company are managers, $3,400,000 bonds, $1,600,000 preferred, and $2,500,000 common stock. The balance of the capital is reserved for future uses of the company. A large portion of the bonds have already been sold. There will be no public offering of the bonds or stocks at this time.

The officers of the new company are: Honorable W. F. Bay Stewart, of York, president; A. H. Haywood, of York, vice-president; David Young, Jr., general manager, and George S. Schmidt, treasurer and secretary. The full board of directors has not been determined.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A Comparison of the Various Methods of Determining the Ratio of the Electromagnetic to the Electrostatic Unit of Electricity.

A long research has been conducted at the Bureau of Standards, Washington, D. C., by Dr. E. B. Rosa and N. E. Dorsey, for redetermining the ratio of the electromagnetic to the electrostatic units of electricity. In this article they discuss the comparative advantages of the various methods of determining this ratio which are available. A report on this matter, presented to the British Association in 1863 by Maxwell and Jenkins, says that there are five available methods. The first is by a common measure of quantity—that is, the measurement of the charge of a condenser and of a flowing current; the second by a comparison of the measure of electromotive force produced by a battery; the third by common measure of resistance; the fourth by a comparison of currents, and the fifth by a comparison of capacity. The first method was used by Weber and Kohlrausch and Rowland. It does not involve the use of a resistance, as do the other four; but the method is difficult and complicated. In the electromotive-force method no condenser need be employed. It has been used by a number of observers, and it is doubtful whether any great improvement can be made in the determination through this method. It requires, however, the knowledge of the unit of resistance, and it is difficult to measure accurately the electrostatic potential. The whole problem, in the resistance methods, lies in measuring the resistance in electrostatic units, and the difficulties are very great. The current method mentioned should really come under the capacity method, since it requires the determination of the capacity of a condenser. This method may be dismissed. The best of all the methods is the method of capacities. There are several ways of determining the capacity—by a ballistic galvanometer, by the steady deflection of a galvanometer, by the Maxwell bridge, by the differential galvanometer, and others. The conclusions the authors reach are, briefly, as follows: Of the four methods available, the quantity method is the most complicated and the least accurate. The electromotive-force method is better, but is likely to be more useful in determining the absolute value of the standard cell when the ratio of the units is taken as known. The resistance method is roundabout, and can not be expected to give results as accurate as the remaining capacity method. Of the various ways of conducting tests by the latter, the Maxwell bridge and the differential galvanometer are the best, and by the use of several different forms of absolute condensers it is thought that thoroughly reliable results may be obtained without further use of the less direct and more difficult methods.—*Abstracted from the Bulletin of the Bureau of Standards* (*Washington*). *October.*

Electrically Driven Air-Compressors.

A brief account is here given by A. F. Bushnell of some striking installations of electrically driven air-compressors now in operation in Montana. Such compressors have been in operation at Butte for six years, the first equipments being placed in the Neversweat Mine, and their success has led to the adoption of similar arrangements at a number of other mines. There are two chief reasons why electric power for compressors is preferable to steam. Under certain conditions, the cost of producing the power is about half that of steam, and the efficiency is about fifteen per cent greater. It is said that two motors in the compressor room at the Original Mine have effected a saving in coal bills amounting to $1,000 a month. The Amalgamated Copper Company has asserted that while it costs $100 yearly to produce one horse-power by steam, it can secure the same amount of electric power at a cost of only $50; and as this company is using approximately 7,000 horse-power yearly in compressing air, it is seen that the saving, by the use of electricity, is presumably $350,000 a year. Instances of the employment of this kind of equipment may be mentioned as follows: The Boston & Montana Copper and Silver Company has constructed a building for three compressors at the Leonard Mine, each of the compressors being driven by a 600-horse-power motor. At the Original Mine there are two 500-horse-power induction motors, each driving a compressor. The largest compressor plant is at the Neversweat Mine, where there is one compressor driven by a 300-horse-power motor which has been running two and a half years. A second, driven by an 800-horse-power motor, has been running five years. In this plant there are still three steam-driven compressors. The Rarus Mine has two electrically driven compressors, and there is one at the Corra. The most modern equipment is at the Bell Mine, where there are four large compressors driven by 600-horse-power motors.—*Abstracted from the Engineering and Mining Journal* (*New York*), *November* 2.

A Plea for the Imaginative Element in Technical Education.

An earnest plea is made here by G. E. Hale for a broadening of the courses usually offered at the technical schools. The author takes the stand that the engineer should have as broad an education as the lawyer or the doctor, and that this can be secured only by eliminating from the courses now offered the work devoted to the study of details, maintaining, however, thorough instruction in principles, and adding studies in other branches of knowledge. He thinks that it would be desirable if every technical student could first secure a collegiate degree, but it seems not practicable at this time to take such a radical step. He suggests that it might be well for one or two colleges to try this experiment. No doubt they would have no difficulty in securing students. It is pointed out also that the engineering profession is growing so rapidly, and the demands upon engineers are increasing in such a way, that this problem becomes yearly more and more difficult. One probable result will be pushing back into the preparatory schools more of the elementary work now usually given at the technical schools, and a curriculum which would enable the student to take work in outside studies. This is desirable, since there is a natural tendency on the part of students, and particularly engineering students, to devote themselves too closely to the particular subject which is interesting them. In many cases it is

true that the student has, from boyhood, devoted most of his attention to such subjects. There is, therefore, all the more need for forcing him out of the rut into which he so naturally falls. The author sums up his suggestions in this way: Provide a greater breadth of view for the technical graduates and require two years of general college work for entrance; provide more general studies and develop the students on social and cultural sides; lay special stress on the importance of fundamental principles, and take the fullest advantage of the educational value of science. He recommends particularly a course of lectures on the theory of evolution in its broadest sense.—*Abstracted from the Technology Review (Boston), October.*

Units Used in Distribution.

Attention is called here by W. A. Toppin to the losses of energy which may take place in an electrical distribution system, and which can be reduced with considerable saving to the supply company. Beginning at the generating station the energy required to excite the field magnets amounts to a considerable number of kilowatt-hours yearly, but this is not generally metered. It is an unavoidable loss, and can not be helped. But it is most important that the meters connected in circuit with each generator, which measure the energy delivered to the switchboard should be correct. On the one hand, the operating force may be anxious for these meters to err on the fast side, while the engineers in charge of the distributing system would prefer to have them err on the slow side. Moreover, the testing of these meters is carried out only with difficulty, because they are almost continuously in use. To obtain a sufficiently large steady current and pressure for a stop-watch test is also difficult in many cases. The most satisfactory way of checking such meters is to arrange circuits so that a portable meter may be connected in for a short period. Each station meter can thus be tested in rotation at the actual load under which it usually works. The designing engineer sees to it that the design of the switchboard is such that no unnecessary loss takes place there, but often the power taken from the switchboard for station purposes, such as lighting and operating motors, is not measured. When this is the case, this power increases the apparent "stray" loss, and if no check is kept over it there is a tendency to wastefulness. A meter is also desirable for checking the consumption of energy in the boiler house, for the stoker, feed-pump and other motors, and a meter should be installed for the motor driving the air-pumps, circulating pumps and boosters. There should, of course, be a meter for measuring the charge and the discharge, wherever a storage battery is used, as this will prevent useless gassing of the cells. Turning, then, to the smaller power consumers, it is shown that the energy used in an instrument amounts to a considerable item during the year. Many of these meters are in service continuously. The shunt current for a wattmeter is about 0.05 of an ampere at 500 volts, so that twelve wattmeters will consume annually 2,620 kilowatt-hours. A 500-volt voltmeter uses about eighty-seven kilowatt-hours a year, and as there are many of these instruments at every station, a respectable amount of energy is consumed in this way. The auxiliary apparatus of the rotary converters, motor-generators, or other power-consuming devices, should be chosen for high efficiency. The author remarks that one of the largest central stations in England loses nine per cent of its output to substations in transformer losses. When coal is high, a few extra dollars spent in making a station more efficient are capital wisely laid out. The apparatus should also be chosen so that it would always be possible to run a machine at an efficient load. The introduction of the high-efficiency lamps brings about a new difficulty, as these lamps, when of small candle-power, do not take sufficient current to cause the present types of wattmeters to record accurately unless a considerable number of them are in use. A turn-down lamp, when at low candle-power, may take less than one-tenth of an ampere, which would not be recorded on any instrument now in use. It is suggested that the loss due to the wattmeter shunts at consumer's premises might be avoided by using recording-current meters, and this practice would be satisfactory if the voltage of the supply were maintained constant. The author then, as an example, assumes that a certain company is supplying 1,000 of its consumers with a three-wire, 500-volt, direct-current system. Wattmeters are used throughout, and 300 consumers have 500-volt voltmeters, and 700, 250-volt voltmeters. There are no substations. Allowing for the losses as indicated above, he finds the total annual loss which occurs in this way to be nearly 88,000 kilowatt-hours, which at one and one-half cents a kilowatt-hour represents $1,320. It is important for the station to receive payment for as much of this energy as possible.—*Abstracted from the Electrical Engineer (London), November 1.*

A Dynamo for Train Lighting.

A description is given here of the new constant-potential dynamo recently discussed before a German society by M. Osnos. This machine is entirely independent, as regards constancy of potential, throughout wide changes of load and speed, and of the direction of rotation. This result is secured without the interposition of a mechanical governor. The essential part of the dynamo is really the exciter, which may be mounted on the same shaft or, in a small unit, combined with the generator itself. The latter consists of a separately excited machine supplying the lamps of the train. The magnetic field is excited by a current drawn from the exciter, which current also flows through a series-exciting coil on the exciter field. At right angles to the two brushes supplying this series-exciting current are two additional brushes, which supply the controlling or auxiliary exciting current for the exciter. In this circuit is connected a small storage battery, which, if it becomes necessary, may be recharged from the main generator, but which usually takes care of itself. This auxiliary exciter circuit produces, in the exciter armature, a magnetic field in line with that set up by the armature reaction. When the difference of potential between the brushes of this auxiliary circuit is low, the current flowing through it is due to the battery. As the potential at the armature increases, since it opposes the battery, this reduces the auxiliary current and eventually reverses it. In this way the armature reaction is controlled, so that the current in the main exciting circuit of the generator will be varied just sufficiently to compensate for the change in speed. The auxiliary circuit may be adjusted once for all, and thereafter there is no need to change it except to change the potential of the main generator. The results of experiments indicate that this arrangement gives an unusually constant potential throughout a wide range in speed and in load. Under special conditions certain changes in the arrangement of the circuits may be made, and as mentioned before it may be desirable to combine the exciter with the dynamo. A proper arrangement of windings for this purpose is explained. —*Translated and abstracted from L'Industrie Électrique (Paris), October 25.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A New Line of Portable Electrical Instruments.

A new line of portable electrical instruments for general service purposes has been brought out by the Whitney Electrical Instrument Company. The object sought in the design and mounting of these instruments has been to provide a portable type, easily carried by one person, and which can be depended upon to withstand, without injury, the shocks and jars which necessarily accompany such use. This has been done by designing an enclosing case which protects all parts of the instrument proper, and by fitting the cases with studs and links so that they can be clamped together in a solid group, easily carried in one hand. Any one who has attempted to handle a number of instruments, as usually mounted, at one time, will appreciate the convenience of the arrangement shown in Fig. 1. Here are two instruments, which may be an ammeter and a voltmeter, attached securely by four links. Beneath them is shown a "utility" box carrying shunts for the ammeter, or any other necessary device, and, at the back of the upper instrument, a small tool box in which are the tools ordinarily needed for connecting up the instruments. Both of these boxes are attached to the instruments so that the whole group makes a solid unit. The links are carried on studs, the bolts of which are turned up at the end so that the nuts can not come off and be lost. When the instruments are disassembled, the links are turned back and clamped under the studs of their own box, so that they are entirely out of the way and unobjectionable. As the Whitney instruments are particularly light, the whole group, as shown, is easily and conveniently carried in one hand.

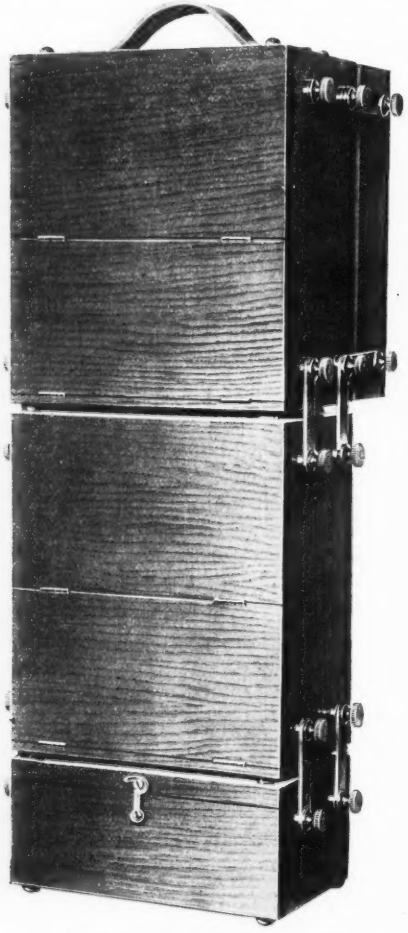


FIG. 1.—GENERAL SERVICE PORTABLES, WITH TOOL BOX AND UTILITY BOX ASSEMBLED FOR TRANSPORTATION.

Fig. 2 is from a photograph of a new direct-current voltmeter open. The substantial character of the box is shown. All the joints are strong and with no unnecessary projections. The voltmeter studs are enclosed and protected when the lid is bolted down and hooked. This space also provides a compartment for carrying the necessary leads. The ammeter and wattmeter are mounted in cases exactly similar in design to that of the voltmeter.

Fig. 3 is from a photograph of the tool box designed to accompany these instruments. It is substantially made and contains pliers, combined with wire-scraper and screw-driver, wrench, wire gauge, foot-rule and knife. The utility or shunt box is merely an empty case large enough to carry a good-sized shunt, or any special tools which may be needed.

In the direct-current instruments, the Roller "wire-guided" movement may be supplied, or the ordinary switchboard movement. The former action is shown in Fig. 4. It was designed to eliminate friction and to provide a mechanism which would not be affected by jars and rough handling. The instrument is of the D'Arsonval type, the movable coil turning in the magnetic field set up by a permanent magnet, about an iron core. The coil is supported on spiral springs, which not only give it the directional force and act as current conductors for the coil, but also support the coil axially so that it is free to move up and down without striking. The coil is held centrally by means of a fine wire passing through ruby jewels. The wire itself may be of phosphor bronze or steel, and it is said that the combined axial and turning motion of the jewel acts most effectively to keep the wire clean and to eliminate friction. The supporting springs are

FIG. 2.—150-VOLT DIRECT-CURRENT, GENERAL SERVICE METER, OPEN, READY FOR USE.

FIG. 3.—TOOL BOX.

attached by one end to the coil, and the other ends are laid into helically grooved sleeves supported by, but insulated from, the carrying bracket. The maker asserts that the effectiveness of this movement has been tested by submitting the instruments to over 50,000 blows each, equivalent to dropping the meter eight or ten inches, without any ill effects whatever. Indeed, it was found that the box itself could be rapped to pieces before the movement was injured. The instruments are dead-beat, as the moving coil is wound on an aluminum form. The insulation has been carefully designed, and ivory sleeves are used where the wire must pass through metal.

The voltmeters of these instruments are self-contained, the resistance being mounted in the box. The ammeters up to seventy-five amperes are also self-contained, the shunts being placed in the case. The larger ammeters are essentially standard milli-voltmeters, and may be used with any of the standard shunts supplied by the maker. In all of these instruments the moving part is protected from outside magnetic influences by a U-shaped band of steel which surrounds the mechanism. This, it is said, is very effective, although it is so light that it adds practically nothing to the weight of the instrument.

The Whitney company also supplies general service instruments for alternating currents. The wattmeters and the higher-potential voltmeters of this line are of the dynamometer type, while the hot-wire movement is supplied in the ammeters and low-potential voltmeters; The latter movement is shown in Fig. 5. Here a fine wire, *a-b*, of suitable metallic alloy, having a relatively high coefficient of expansion, is attached at one end to the plate *c*, then passes around the small pulley *d*, the other end being attached to, but insulated from, *c*; *c* is kept under tension by a spring *f*. To the pulley *d* is attached a light bifurcated arm *g*, and between the ends of the fork is a fine silk fibre passing around a light pulley *h*, to which is attached the pointer. Current is led through the *a* section only of the wire *a-b*. This current, of course, tends to lengthen that part of the wire, and, due to the tension of the spring *f*, this will cause the arm *g* to be deflected so that the pointer will be turned about its pivot. Ordinary changes in temperature, however, affect equally both sections of the wire *a-b*, which will therefore lengthen equally, and there will be no rotational effect. This compensates for temperature changes. The arrangement also makes it possible to apply but a light stress to the expansion wire, so that the fatigue error is much reduced, and high sensibility is attainable. The whole movement, as shown in the figure, is mounted on a base plate, and may be moved about a pivot, through a slight angle, so as to correct for any zero error due, for instance, to a bent needle.

The hot-wire instruments for currents over twenty-five amperes are supplied

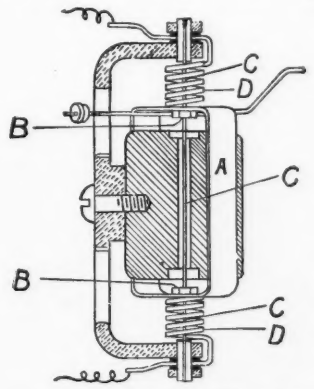


FIG. 4.—DIRECT-CURRENT WIRE-GUIDED MOVEMENT.

with separate shunts. These are of the alternating-current switchboard type with clamp screws provided with wing nuts, so that they may be tightened with the fingers. The voltmeters for less than seventy-five volts are fitted with the hot-wire movement. For voltages higher than

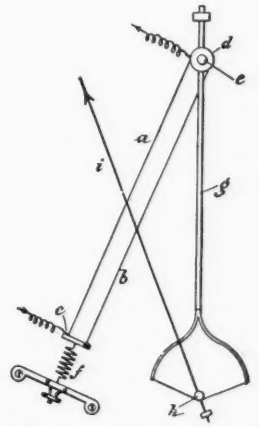


FIG. 5.—ALTERNATING-CURRENT HOT-WIRE MOVEMENT.

this the advantages of the hot-wire type are not so great, and these instruments are fitted with a regular dynamometer movement, the construction of which is simple and substantial. The instruments are made dead-beat by means of air vanes, and the same damping device is attached to the wattmeters.

The following are the dimensions of the instruments of this general service type. The cases are of standard size, being six and three-quarters by seven and one-half by four inches outside. The average direct-current instrument weighs about five pounds, and the alternating-current instrument about three pounds. The tool box is six and three-quarters by seven and one-half by one and three-quarter inches and weighs complete about two and one-half pounds. The "utility" or shunt box is six and three-quarters by five by four inches, weighing less than twenty ounces when empty.

The instruments are guaranteed by the makers, and adjusted to be accurate within one per cent at the normal working range. Any necessary repairs or recalibration resulting from normal use during the first year's service are made without charge.

The general sales agent for the Whitney Electrical Instrument Company are Machado & Roller, 203 Broadway, New York city.

Electric Switching Locomotive for the Bush Terminal Company.

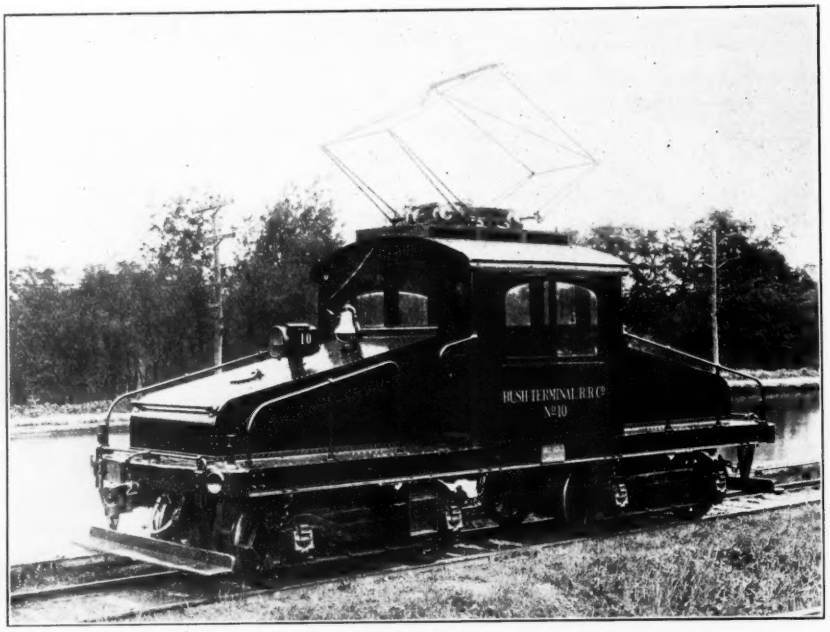
The Bush Terminal Company employs for switching purposes, around its extensive docks and warehouses in South Brooklyn, a number of steam locomotives, and one electric locomotive. The latter was built by the General Electric Company about three years ago and has given such satisfaction, in the way of tonnage capacity, ease of control, and low cost of maintenance that the company has recently given an order for a second electric locomotive.

The new machine has been jointly completed by the General Electric Company and American Locomotive Company, and some illustrations of this machine are presented in this article and show some features of the locomotive which are worthy of comment.

While the truck is a bar-frame equalized design, the construction adopted differs from that ordinarily used on electric motor trucks and follows rather a type which has been used with a good deal of success for the tender and guiding trucks of steam locomotives. The bolsters are carried rigidly on the side frames, and the weight of the frame and bolster is transmitted to the equalizers through one semi-elliptic spring on each side instead of through bolster springs and helical side springs as is the customary construction in the so-called Master Car Builders' equalized truck. This produces a simple,

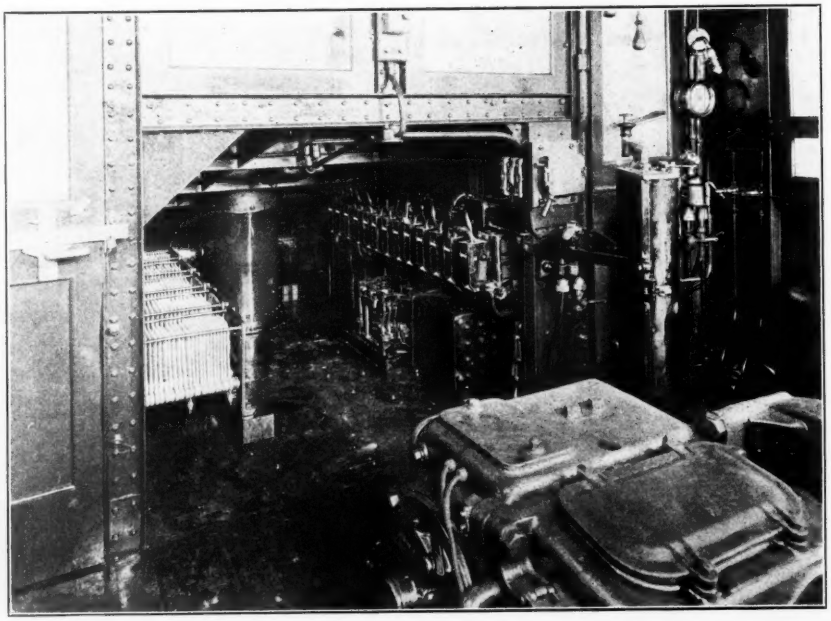
substantial form of truck suitable for locomotive service, and having a low cost of maintenance in such service.

The driving axles are six inches in diameter, of forged steel, with thirty-



Electric Locomotive for Bush Terminal Company.

six-inch fused-steel-tired wheels. Each truck is equipped with two GE-55-A (ninety horse-power) two-turn motors, with a gear ratio of 52-21. These motors



Interior View of Electric Locomotive for Bush Terminal Company.

with this gearing will give at their one-hour rating a tractive effort of 3,000 pounds per motor, or 12,000 pounds per locomotive, at a speed of approximately eighteen miles an hour.

The cab is built of sheet steel, supported by a framework of small angles, and consists of a main operating cab, and sloping end cabs, with narrow side platforms extending from the main cab to the ends of the locomotive. The floor of the locomotive is three-eighths-inch sheet steel, but the floor of the main operating cab is covered with a three-fourths-inch wood covering.

Fig. 2 shows the arrangement of apparatus in the cab. The locomotive is equipped for both straight and automatic air, and in the centre of the main cab is a CP-23 air-compressor, having a capacity of fifty cubic feet per minute, and supplying air for the brakes. In the operating engineer's corner is located a C-6 master controller and the valves and handles for operating the combined straight and automatic air. In the end cabs are located a sand-box, air-drum, contactors and rheostats. As the locomotive is to be used solely for switching service, it is supplied with a pantagraph trolley, instead of the ordinary wheel trolley, thereby obviating the necessity of the frequent reversal of the trolley which would be necessitated in such service.

The locomotive is equipped with bell, whistle and headlights. The headlights are supplied with thirty-two-candle-power incandescent lamps, and gauge lamps for illumination of the instruments are wired on the headlight circuit and controlled with the same switches.

The principal dimensions of the locomotive are as follows:

Length over bumpers	**29 feet**
Height over cab	**11 feet 9 inches**
Length of rigid wheel-base	**6 feet 6 inches**
Track gauge	**4 feet 8½ inches**
Weight on drivers	**80,000 pounds**

Curtis Turbines in Japan.

In the purchase of power machinery, the Japanese have taken advantage of modern ideas and, anticipating the progress to be made by the development of the steam turbine, were early in the market for that type of prime mover, and a great many American steam turbines have been installed in that country. Among these, a total of sixty-nine units, aggregating 60,000 horse-power, of the Curtis type of turbo-generator, manufactured by the General Electric Company, Schenectady, N. Y., have been installed.

These sixty-nine machines are distributed as follows: Chita cotton mill, one twenty-five-kilowatt unit; Fuji cotton mill, two 1,000-kilowatt units; Hakata Electric Light Company, one 500-kilowatt and one twenty-kilowatt units; Ichinomiya cotton mill, one twenty-five-kilowatt unit; Imperial Steel Works, one twenty-five-kilowatt unit; Imperial Government Railway, one thirty-five-kilowatt unit; Kawasaki Dockyard Company, Kobe, one 500-kilowatt unit; Kaneko cotton mill, Osaka, one twenty-five-kilowatt unit; Kure Naval Dockyard, one 500-kilowatt unit; Maidzuru Naval Dockyard, one 300-kilowatt unit; Miye cotton mill,

Osaka, two twenty-five-kilowatt units; Miike mine, Omuta, three 1,000-kilowatt units; Nisshin cotton mill, two 1,000-kilowatt units; Nagoya Electric Light Company, two 500-kilowatt and one twenty-five-kilowatt units; Oji Paper Company, one 500-kilowatt unit; Osaka Electric Light Company, four 500-kilowatt and two 1,000-kilowatt units; Osaka Military Arsenal, Osaka, eight 500-kilowatt units; Osaka Municipal Railway, three 1,000-kilowatt units; Sanyo Railway Company, one twenty-five-kilowatt and one fifteen-kilowatt units; Saseho Naval Dockyard, two 500-kilowatt units; Senju woolen mill, one 150-kilowatt unit; Tokyo Electric Light Company, one 500-kilowatt unit; Tokyo Military Arsenal, Tokyo, four 500-kilowatt and two 500-kilowatt units; Tokyo Military Arsenal, Oji, three 500-kilowatt units; Tokyo Railway Company, five 1,500-kilowatt units; Tokyo cotton mill, three 1,000-kilowatt units; Tenma Weaving Company, two twenty-five-kilowatt units; Yokohama Union Electric Light Company, two 500-kilowatt, and one 1,000-kilowatt units.

The "National" Rheostat.

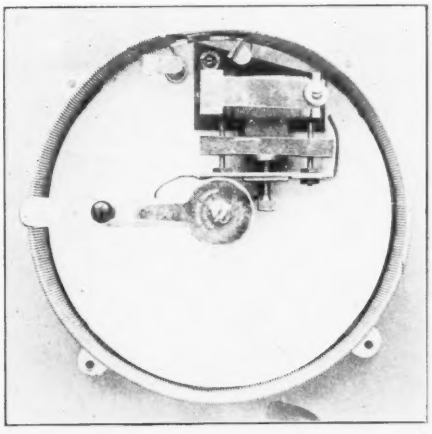
The accompanying illustrations show a new form of rheostat placed on the market by the National Rheostat Company, 115 Franklin street, Chicago, Ill. This is a continuous-wound rheostat with a lever making direct contact on the edge of the band. By reason of its construction, the necessary length of wire is placed in the smallest possible compass. The main line current is brought into the centre post and from there passes over the lever, making direct contact with the edge of the wound band. In this way from three to four hundred steps are secured, and it is stated that an absolute speed control for motors not attainable by the old methods has been secured.

The construction of this rheostat enables it to perform the duty of a starting box as well as a speed controller with the same movement of the lever. The connections are made at three points near the top of the instrument, the centre one being for the line, the one at the left being to the armature, and the one at the right to the field. The lever moves to the right in the direction of the hands of a watch, and in going off of the stop, the full current is first thrown into the field with all the resistance in the armature, and as the lever is moved around the circle, the resistance is gradually cut out of the armature, and in such a manner that even with a comparatively rapid movement of the lever the starting of the motor is perfectly smooth.

Both the line break and the overhead release are contained inside of the case, and require no attention from the operator. In the no-voltage release the line

"National" Rheostat.

current is brought into the magnet coil from the centre connection to the left-hand end of the coil. The connection for this line is shown by the head of the screw and the washer between the two posts. The wire itself is attached to the head of the magnet coil. The current passes from this through the magnet spring to the head at the other end of the coil, and goes through the winding, thus producing the magnetism to hold the head of the spring in contact and complete the circuit. The other end of this wire is attached to the centre post, and the line current thus brought into the



Arrangement of Lever-Arm and Auxiliary Devices, "National" Rheostat.

centre of the instrument, where it passes out over the lever to the band.

When the lever is at the top of the instrument the circuit is open, but as soon as it touches the right-hand post the circuit is closed and a full line current thrown into the field. At the same time the coil is magnetized, and while the spring contact on the top of the coil is first made by mechanical contact of the lever pressing on top of the spring, as soon as the coil is magnetized the lever can then be moved away from the spring, and the contact is maintained by the magnetic pull. The lever then can be moved around to any point on the instrument that may be desired, and with the line current passing continually through the coil, the magnetic contact is maintained.

As soon as the switch is pulled or any break occurs on the line, the coil immediately demagnetizes by reason of the failure of the current, and the contact at the top is released by the spring. The switch can then immediately be thrown back without waiting for the motor to stop, as the break occurs on the main line before the current passes into the rheostat. No further action can take place until the lever is brought back on the stop, thus making the mechanical contact by the pressure of the lever on the contact spring and moving the lever off again on to the band, completing the circuit.

The overload break is attached to the same coil, and is operated by the same magnetic current, and in principle is simply switching the main line current around the coil directly on to the centre post whenever the bar strikes the coil heads by being raised by the magnetic pull. The bar makes a direct circuit from both heads at each end of the coil on to the spring at the right-hand side, and from there by a wire jumper to the centre post. This part of the apparatus is entirely isolated from the coil until the bar is raised and strikes the heads. The adjustment of the raising of this bar is made by the centre set-screw. A quarter turn of the screw makes a difference of about one ampere, and in this way the overload break can be set at any point desired.

These instruments can be mounted on the machine, as well as on the wall. The mechanical construction consists of a steel band with a fireproof insulation, wound with the necessary size and length of resistance wire. This is mounted either on a porcelain or slate block with a pressed-steel cover, so arranged as to give proper ventilation.

The Strowger Automatic Telephone Company stockholders will hold a special meeting in Chicago on December 19 to ratify the consolidation with the Automatic Electric Company. Stockholders of the latter will meet immediately afterwards and authorize the mortgage for $1,000,000, against which six per cent, twenty-year bonds of an equal amount are to be issued. Strowger stock will be exchanged on the basis of $20 per share for the new bonds.

Current Electrical News

DOMESTIC AND EXPORT.

SOUTHERN PACIFIC AWARDS POWER CONTRACTS—E. H. Harriman, president of the Southern Pacific Company, has issued a statement to the effect that contracts have been let for building the Fruitvale (Cal.) power-house, which will be the centre of the electrification of the Southern Pacific's Oakland and Alameda surburban lines. Since the fire of last year the company's bay ferries have been carrying 2,000,000 passengers a month, or almost double the average before the disaster. Electrifying the connecting shore lines seemed to be the only solution of the problem and the work will be pushed to completion as rapidly as possible. The company's engineers also have under investigation the use of electric power in crossing the Sierra Mountains.

POWER PLANT FOR NEVADA—It is proposed to construct a power plant on the Truckee river near Clarks, twenty-five miles east of Sparks, Nev. The development is being carried out by Percy Gardner, and the site selected for it is on Southern Pacific land. According to the drawings, the river will be dammed at the location point. The fall will be sufficient to develop about 5,000 horsepower. The current will be sold in Olinghouse, Hazen, Fallon and Fairview. A water right to the Truckee river has been issued to Mr. Gardner by State Engineer Nicholas. Articles of incorporation have been filed for the Lower Truckee Power Company, capitalized at $500,000. The incorporators are: T. W. Gaines, of Oakland, Cal., W. H. Hall, of Gridley, Cal., and H. W. Esden, of Wadsworth, Nev., who will be resident agent of the company at Reno, Nev.

NEW ELECTRIC LINE—A $1,500,000 corporation has been organized in Walla Walla, Wash., and articles of incorporation as the Washington-Oregon Traction Company filed with the county auditor. One of the main objects of the company is to construct seventy-five miles of railway, to be operated by electricity created by the Wenaha river, twenty-five miles from Walla Walla. Members of the company assert they will operate steam and electric railways, steamboat lines, and act as common carriers. One of the objects of the company will be to generate electricity for commercial purposes at nominal cost. Within the next year or eighteen months the company expects to be actively engaged in actual development work, operating in Washington, Oregon and Idaho. The company will be one of the largest in this section, and the capital will be furnished by local men. The incorporators are: Max Baumeister, Allen H. Reynolds, Samuel Drumheller, C. K. Holloway, John Smith, W. A. Ritz, E. S. Isaac, J. L. Sharpstein. These men will act as trustees until March, 1908.

NEW MANUFACTURING COMPANIES.

ALBANY, N. Y.—The United Consumers' Electric Company, of Brooklyn, has been incorporated with the secretary of state, to do a general electrical contracting and manufacturing business. The capital stock is placed at $10,000, and the directors are Frederick L. Sleaster, Lawrence O'Byrne and George Fuller, of Brooklyn.

MONTGOMERY, ALA.—The Andrew Railway Safety Appliance Company, with a capital of $2,500,000, has been incorporated at Montgomery, to build and sell the device patented by James T. Andrew to prevent accidents on railroads. A number of leading business men of the state are interested with Mr. Andrew and will push the business.

NEW PUBLICATION.

THE "PACIFIC TELEPHONE MAGAZINE"—The "Pacific Telephone Magazine" is published monthly in San Francisco, Cal., for distribution among its employés, by the Pacific Telephone and Telegraph Company. The November issue contains a portrait of Edward H. Bangs, chief engineer of the company, considerable editorial matter, and sketches of interest to the telephone fraternity.

TELEPHONE AND TELEGRAPH.

OIL CITY, PA.—The Postal Telegraph-Cable Company has practically rebuilt its system between Oil City and Bradford.

FROSTBURG, PA.—The Chesapeake & Potomac Telephone Company is making improvements to its lines in this city and toward Cumberland.

HIGH POINT, N. C.—The Southern Bell Telephone Company has purchased a site on which it will erect a handsome building for local service.

ST. ALBANS, VT.—The Orange County Telephone Company has begun the work of building a trunk line from Randolph to Northfield. A metallic system is to be installed next spring.

GADSDEN, ALA.—The telephone and telegraph companies of the city are preparing to comply with the ordinance passed by the city council requiring all wires to be placed underground.

NEW BRITAIN. CT.—The Southern New England Telephone Company has secured a right of way to string its wires west of the tracks of the New York, New Haven & Hartford railroad, between Elmwood and Newington.

SALT LAKE CITY, UTAH—The Nevada Telephone Company hopes to establish communication between Salt Lake and Wells, Elko and Tuscarora, by Christmas. A contract has been let for 300 miles of copper wire.

GARY, IND.—By a unanimous vote the board of trustees of Gary awarded the Chicago Telephone Company a franchise to endure for fifty years and the company will at once begin the construction of a temporary exchange.

LANSING, MICH.—A contract has been let by the Citizens' Telephone Company for the construction of its new building, in which will be installed a complete automatic telephone system. The building will cost $20,000 and will be constructed by George Hagameir.

CHEHALIS, WASH.—Chehalis is to have an independent telephone system, B. E. Clement having accepted the franchise which the city council recently voted him. He is closely allied with the new Northwestern Long Distance Telephone Company and promises a great improvement in service.

ROCK ISLAND, ILL.—The Union Electric Telephone and Telegraph Company has let the contract for a line between the tri-cities and Clinton, to be in operation about January 1. This will give connection with a number of important Illinois cities, including Sterling, Aurora, Elgin and others.

GALLATIN, TENN.—The Summer County Home Telephone Company, which recently reached Gallatin with its pole construction, has begun work on an exchange at Portland. Connection with Westmoreland will be made through Bethpage. Poles are on the ground between that place and Portland.

TOPEKA, KAN.—A long-distance telephone-telegraph line will be built to run from the general superintendent's office in Newton to the Santa Fe general offices in Topeka, a distance of 135 miles. Two copper wires are being put in for the line, which will be restricted to the use of the railroad officials.

EAST BLOOMFIELD, N. Y.—Residents of East and West Bloomfield, Victor, Richmond, Bristol, South Bristol and Naples have formed a telephone company to build a system connecting these towns. Poles and material have been purchased and the line is being located. Connection will be made with other lines.

JACKSON, MICH.—An effort is being made to organize a new telephone company at Flint to connect with the lines of the Citizens' in Jackson; the Oakland Telephone Company in Oakland county;

the Homes lines in Detroit and the Washtenaw in Ypsilanti and Ann Arbor. J. W. Martin, of Detroit, is the promoter of the project.

YOUNGSTOWN, OHIO—Youngstown now has telephonic communication with Berlin Center through the Berlin Center Telephone Company. The Berlin Center company connects with the Youngstown independent company through North Jackson, and with Alliance and Canton through North Benton and Damascus.

WAREHAM, MASS.—The new telephone line from Rockland to Assinippi, for which a franchise was granted a number of weeks ago, is now being installed. The line to Assinippi covers the same territory as the line in service there nearly fifteen years ago. It was one of the first lines in operation in this section.

NORFOLK, NEB.—The Norfolk Telephone Company will place on the market an issue of $50,000 six per cent semi-annual gold bonds. The stock will not be placed immediately, but purchasers of bonds will be given stock to the amount of fifty per cent of their bond holdings. The company's capital stock is $50,000.

FLINT, MICH.—Joseph W. Martin, of Detroit, is backing a new telephone company which is seeking to gain a foothold in this city. It is understood it contemplates a working arrangement with the Valley company and the rural telephone exchanges throughout the county in opposition to the Michigan State Telephone Company.

ELIZABETH, N. J.—The Hudson & Middlesex Telephone Company contemplates extending its lines to include this city. In a communication to the city council, W. J. Lansley, the company's manager, asked that body to fix a date for the appearance of the concern's representatives, who will then make a plea for a franchise.

WESTFIELD, MASS.—The New England Telephone and Telegraph Company is building a new line between Westfield and Russellville, in Southampton. There will be six miles of poles and the route followed is along the Montgomery road and thence along the highway to Russellville. The telephones on this new line will be a part of the Westfield exchange.

CINCINNATI, OHIO—Ground has been broken for the new Bell Telephone exchange building at the intersection of Highland and Mt. Pleasant avenues. The exchange will take care of all lines of the Highlands, Bellevue, Dayton and the territory as far south as Cold Spring. The exchange will be constructed of pressed brick, and is built to relieve the congestion in the Covington South Exchange.

MT. CLEMENS, MICH.—The city council has refused a franchise to the Home Telephone Company of Detroit. Members of the council claim that they found no advantages offered in the franchise, and that a careful inquiry among business men revealed no sentiment in favor of another telephone system. Representatives of the Home company have offered a new and more liberal franchise which is now in the hands of the committee on ways and means.

SHENANDOAH, PA.—The Farmers' Independent Telephone and Telegraph Company has been organized by agriculturists of the Ringtown Valley. The capital stock is $3,000. The line will extend from Shenandoah to Ringtown, thence to Aristes, there to connect with lines to Mount Carmel and Shamokin, also northward from Ringtown toward Bloomsburg and Wilkes-Barre, and northeast to Sheppton, Nuremburg and Hazleton. The board of directors includes Elmer Dennison, Alexander Manbeck, David Davis, David Horn, Alfred Teter, W. L. Witmer, Charles Laudig, J. A. Mandour, B. F. Zimmerman, R. W. Faust, T. W. Rumble, Clarence Lindemuth, and W. F. Lyons.

DUNNVILLE, ONTARIO—A deal has been closed by which the Bell Telephone Company ceases to do business in the territory covered by the system of the Dunnville Consolidated Telephone Company. This territory includes the entire county of Haldimand, the township of Tuscarora in Brant county, the townships of Caistor and Gainsboro in Lincoln, and that portion of Wainfleet in the vicinity of Winger. The Consolidated company has purchased the poles, wires and all other outside plant of the Bell Telephone Company in this territory except what is reserved for long-distance service. The Bell company agrees to maintain no exchange and do no local business in this territory during the term of agreement, which is for ten years, and as much longer as the two companies desire, it being terminable after ten years on sixty days' notice prior to the expiration of any yearly period. The Bell company will handle all the long-distance business, and for this purpose will have an exchange at Cayuga, but nowhere else in the district.

LAS CRUCES, N. M.—The Silver City-El Paso & Southwest Telephone Company has purchased the Texas & New Mexico Telephone Company's line between this place and El Paso. Charles Miller was the principal stockholder. The Silver City-El Paso & Southwest Telephone Company is practically a new company which is now installing a long-distance line, connecting El Paso, Las Cruces, Rincon, Engle, Los Palomas, Silver City, Deming and all intervening towns. The company is capitalized for $100,000. The men who are the principal stockholders are also interested in the local telephone business in the various towns named, and include John H. Morgan, of El Paso, who is the manager of the Southern Independent Telephone Company, of that place; W. E. Baker, of the Las Cruces exchange; William D. Murray, president of the Silver City Telephone Company and C. B. Bosworth, of Deming. The line is about completed and will be ready for operation in a short time. The lines in the Rio Grande valley are already working. Connection is made with the Automatic system at El Paso.

NEW INCORPORATIONS.

LANSING, MICH.—Carroll Light and Heat Company, Grand Rapids. $50,000.

LANSING, MICH.—North Parma Telephone Company, North Parma. Increase of capital stock from $5,000 to $10,000.

MADISON, WIS.—Neshkoro Telephone Company, Neshkoro. $2,000. Incorporators: Charles Dahlke, Charles Marks and J. S. Kruger.

ALBANY, N. Y.—Walton People's Telephone Company, Walton. $30,000. Incorporators: E. Burnam Guild, W. J. Cranston, E. L. Jenks, Walton, N. Y.

MADISON, WIS.—Economic Light and Power Company, Marinette. $25,000. Incorporators: Adelbert Gillette, Theodore A. Pamperin and George Beyer.

COLUMBUS, OHIO—Newcomerstown Light, Heat and Power Company, Newcomerstown, Tuscarawas county. Increase of capital stock from $25,000 to $100,000.

COLUMBUS, OHIO—George F. Grove Electric Company, of Dayton. $15,000. Incorporators: George F. Grove, F. A. Corson, A. L. Grove, William H. Ware and Aldora Corson.

NEW ORLEANS, LA.—Mamou Power Company. To construct and operate electric and power plants. $20,000. Incorporators: Charles D. Hill, John Clegg and Phil S. Gidiere.

LANCASTER, KY.—The Kentucky Telephone and Telegraph Company. $10,000. Stockholders: J. W. Elmore, H. V. Bastin, H. T. Logan, James I. Hamilton, Frank B. Marksbury.

LITTLE ROCK, ARK.—The Ozark Telephone Company, of Pocahontas. $25,000, of which $15,000 is subscribed. Incorporators: E. Dalton, president; Mary E. Dalton, Thomas W. Campbell, G. A. Davis and G. D. Wells.

MINNEAPOLIS, MINN.—Northwestern Interurban Railway Company of New Jersey. To connect Fargo and Moorhead with the summer resort at Detroit Lake by trolley. $1,500,000. Incorporators: H. A. Coghlan, S. A. Anderson and J. R. Turner.

ANACONDA, MONT.—Granite Power and Light Company. To operate a power plant on Flint creek, Granite county. $250,000. Directors: Charles H. Joy, of Chicago; George H. Savage, of Butte; William Bennett, of Helena; M. E. Estep, of Chicago, and J. B. Featherman, of Drummond.

SPRINGFIELD, ILL.—Woodstock, Marengo, Genoa & Sycamore Electric Railway Company, Chicago. To construct a line from Woodstock, McHenry county, to Sycamore in DeKalb county. Incorporators and first board of directors: Charles A. Spenny, Edward B. Harang, M. W. Powell, H. S. Hedberg and E. C. Spinney.

SPRINGFIELD, ILL.—Belleville & Interurban Railway Company, Belleville. $100,000. To construct a line from the city to Belleville to the village of Smithton, St. Clair county, Ill. Incorporators and first board of directors: Jacob Gundlach, Jr., Benjamin A. Gundlach, R. W. Hofsommer, George Hippard and Thomas A. Bell.

ELECTRIC RAILWAYS.

RIVERSIDE, CAL.—Construction work on the new trolley lines from Riverside to the new cement town of Crestmore has been begun.

BOSTON, MASS.—The railroad commissioners have authorized the Worcester & Holden Street Railway Company to issue $40,000 capital stock at par.

LINCOLN, ILL.—Officials of the McKinley system have announced that the new line from Lincoln to Mackinaw will be completed by January 1, 1908.

ELKINS, W. VA.—At a special session of the county court the Elkins Electric Railway was granted a franchise to construct and maintain its lines upon the county roads in Leadsville, Roaring Creek and Beverly districts.

NAZARETH, PA.—Plans are being made by capitalists and promoters to build a trolley line that will connect Wind Gap with Stroudsburg. Both towns have been canvassed in reference to the project, and enough capital has been pledged to warrant the beginning of the work early next spring.

HOT SPRINGS, ARK.—A project is under consideration at Hot Springs for the construction of a traction belt line about twelve miles in length to run along the Malvern road to the south, making a circle around Potash Sulphur Springs, and returning to Hot Springs by way of the old Benton road.

PLYMOUTH, IND.—The city council has granted a forty-year franchise to the Indianapolis, Logansport & South Bend Electric Railway Company. It is said that the funds are in sight for building the road from South Bend to Plymouth, and that the road between these points will be completed and cars running within eighteen months.

PUEBLO, COL.—The city council has passed a resolution granting to M. Douthitt an extension of forty-five days from October 31 in which to begin construction of his interurban electric railway from Pueblo down the Arkansas valley. Mr. Douthitt had all plans made for the beginning of work during October, but the crisis in the money situation caused him to postpone the work for several weeks.

HOUSTON, TEX.—The county commissioners have granted a franchise to the Houston Electric Company, permitting it to use the Harrisburg road for an extension of the street railway lines to Harrisburg. A resolution was passed granting the franchise for a period of twenty-eight years, this being done to bring the new franchise into conformity with the one held by the company from the city of Houston.

ANNAPOLIS, MD.—The Washington, Baltimore & Annapolis Electric Railway Company has broken ground in Annapolis for its system of trolley tracks through the city. Under the provisions of the franchise granted the company by the municipality, the work must be done by January 1, 1908, and cars running by the following July. The company expects to have its system of city tracks laid before the time limit expires.

NASHVILLE, TENN.—The Memphis, Covington & Northern Railway Company has been chartered by the secretary of state. The company is capitalized at $14,000, with the following incorporators: G. B. Gillespie, John T. Garner, J. B. Witherington, W. M. Abernathy, H. N. Sullivan, C. H. Stovall, W. A. Black and R. W. Sanford. The purpose of the corporation is to construct and operate a street and interurban railroad in Covington and in the counties of Tipton and Shelby.

COLORADO SPRINGS, COL.—The construction of the first section of the street railway to the summit of Cheyenne Mountain has been begun under the supervision of Colonel Lewis Ginger, who has organized the company for pushing the work. The section will be 800 feet in length and the incline will be of thirty-five degrees. The cars will be the first of the kind ever used in the country and will be run on the elevator principle by a patent device which has been invented by Colonel Ginger.

MILFORD, MASS.—At the annual meeting of the stockholders of the Milford & Uxbridge Street Railway Company the following board of directors was elected: John T. Manson, Joel A. Sperry, J. Willis Downs, Charles E. Graham, of New Haven; Sydney Harwood, of Newton; George Albert Draper, of Hopedale, and James E. Walker, of Milford. At the election of officers J. T. Manson was chosen president; J. Willis Downs, vice-president; Wendell Williams, clerk and attorney; James E. Walker, treasurer; and Walter L. Adams, superintendent.

CLEVELAND, OHIO—The Millersburg & Eastern Railroad Company, an enterprise in which Cleveland capital is interested, has been organized. The incorporators are: O. S. Olmstead, Dan M. Miller, W. W. Adams, of Millersburg, and Samuel P. Dunn and J. A. Burke, of Cleveland. The new line will run between Millersburg and Beach City, a distance of twenty-six miles. Work will be commenced within a few weeks, and it is expected to have the line in operation late in 1908. The new company was incorporated for $1,000, which will be increased to $500,000.

SPRINGFIELD, ILL.—Stockholders of the proposed interurban line between Champaign and Bloomington have completed arrangements for beginning work at once. Reports from the treasurer show $200,000 on hand for the construction of the first section of the new line, which will be started at the Champaign end. Franchises have been secured from the towns which will be touched by the new road. Cars will enter Bloomington over the tracks of the Illinois Traction System. John Pitts, of Bloomington, was chosen president at the meeting, and J. A. Keenan, of Leroy, was elected treasurer.

MARSHALLTOWN, IOWA—Fifty thousand dollars in stock has been sold to local capitalists, who, with Hamilton Browne, of Chicago, and other Chicago capitalists, have joined together and organized a company for the purchase of the property of the Marshalltown Light, Power and Railway Company. The sale price is said to be $350,000. The new company is to make extensive improvements to the gas plant, and the street-car line within the city is to be extended. The street-car system is to be also the nucleus of an interurban line between this city and Melbourne. A survey of the right of way has already been made.

YOUNGSTOWN, OHIO—At a special meeting of Ohio and West Virginia capitalists, held at East Liverpool, the initial steps toward the completion of a trolley line from Youngstown to Pittsburg were taken, and it is probable that within the next two years the project will have been completed. The action taken was the organization of a company to construct an electric line from Chester, W. Va., to Carnegie, Pa. Considerable encouragement is being given the project along the entire line. The line will open up many new localities and the indications are that work will be started at once. At Carnegie, which is about eight miles from Pittsburg, connection will be made with the Pittsburg railway lines for Pittsburg, and at Chester with the Youngstown & Ohio river line, which is now being built between East Liverpool and Lisbon and which will be in operation within a short time. At Lisbon connection will be made with the Youngstown & Southern for Youngstown.

PHILADELPHIA, PA.—Brown Brothers & Company and E. B. Smith & Company have undertaken to finance the construction of a bridge to connect Allentown and South Allentown. The structure will cost $400,000 and will be of modern steel construction. It is to form a connecting link in the system of electric railways owned or leased by the Lehigh Valley Transit Company, a corporation also financed by the banking houses named. Work has been begun on the bridge construction and the plans call for its completion in eighteen months. The banking firms named have purchased the old Allentown & South Allentown Bridge Company and the Allentown & South Allentown Street Railway Company. These companies several years ago began the operation but were compelled to leave the work unfinished. The work will be financed when completed by an issue of mortgage bonds, guaranteed by the Lehigh Valley Transit Company, which company will own all the stock. The officers of the old companies have resigned. John C. Dawson, of Brown Brothers, has been elected president. Albert E. Turner, of E. B. Smith & Company, secretary, and B. W. Frazier, treasurer. These officers and Colonel H. C. Trexler and Edward M. Young, of Allentown, constitute the board of directors.

PERSONAL MENTION.

MR. E. J. DICKSON, of Boston, Mass., has been appointed general manager of the Milford, Woonsocket & Attleboro Street Railway Company, with headquarters at Franklin, Mass.

MR. FRANK H. GOLDING has assumed the duties of manager of the Rockford (Ill.) Edison Company. Mr. Golding has been in the electric lighting business for a number of years, having been assistant manager of the Dayton (Ohio) Lighting Company for some time.

MR. GEORGE R. FOLDS has assumed the duties of general manager of the West Penn Railways Company's lines in Westmoreland and Fayette counties. Mr. Folds' headquarters will be in Connellsville, Pa. Mr. Folds resigned as general manager of the South Chicago City Railway Company and the Hammond, Whiting & East Chicago Electric Railway Company to accept the position with the West Penn Railways. He was born in Oshkosh, Wis., August 23, 1870, and later his parents moved to Minneapolis, where he entered into the railroad business. For some time he was connected with the Minneapolis Street Railway Company, and later with the Twin City Street Railway Company. In 1899 he was placed in charge of the claim department of the St. Paul division of the company, later going to the Chicago company.

MR. EUGENE McOUAT, co-inventor with Dr. H. W. F. Lorenz of the new "Zenith" incandescent lamp, entered the lamp business when a boy in November of the year 1879, with the United States Electric Company, of New York city, which was then making the Hiram Maxim paper-filament lamp. Following this employment, for several years he was employed in experimental work on lamps for Dr. Edward Weston, in his laboratory in Newark, N. J. Mr. McOuat was also connected with the Westinghouse company in the lamp department, both in Pittsburg and in New York. For several years he was superintendent of the Beacon Lamp Company, of Boston, Mass. Mr. McOuat is at present superintendent of the Anchor Lamp Company's works at Newark, N. J. He has made several improvements in incandescent lamps, and, in addition to the patents which have just been issued to him, has received patents No. 481,047 (1892) and No. 694,068 (1902), which were both considered very good forms of lamps, several similar lamps having since been put upon the market. He was also associated with several other patents of a like character.

MR. EUGENE MCOUAT.

DR. H. W. F. LORENZ.

About seventeen years ago he began to make a special study of filaments and was successful in producing a high-grade silk filament. A few years later he took up the making of cellulose filaments, and has worked steadily to improve the efficiency of this type of filament. The filament used in the "Zenith" lamp is the result of experiments worked out by Mr. McOuat and Dr. Lorenz. Dr. Lorenz is a native of Springfield, Ohio. After graduating from Wittenberg College he spent over four years in Europe, studying chemistry and physics at the universities of Tübingen and Berlin, Germany. He received the degrees of A.M. and Ph.D. from the latter university in 1898. For a time he was assistant to Professor Gabriel in the Chemical Institute of Berlin University. Later he was instructor in organic chemistry at the University of Pennsylvania for two years. For the past few years he has been engaged in independent technical work.

ELECTRICAL SECURITIES.

The storm centre of financial disturbance, it appears, has moved from Wall street and is being dissipated throughout the southern and western country. The result of this has been the withdrawing of a number of accounts by interior towns from New York banks, and this has disturbed the liquidation of credits, because the New York financial institutions now are accepting drafts on interior banks "for collection only," and declining to allow those who deposit the checks to draw out the money against them until the checks have actually been paid. It seems certain that the whole situation is clearing. The bank and domestic exchange troubles are lessening, and the premium on currency is slackening, because there is a smaller demand for cash and because the offerings of currency are constantly increasing. Over $65,000,000 in gold has been bought abroad, and the bank-note circulation throughout the country has been increased $20,000,000 in the last couple of weeks. The basis of this circulation will soon be enlarged $50,000,000 by the issue of Panama Canal bonds that the banks have agreed to take, with the understanding that the money paid for the bonds shall be left on deposit by the Government with national bank depositaries. Supplementing this comes the offer of the Government of new three per cent bonds, which will attract the hoards of those investors who are glad of such an opportunity, but who dared not invest their money in securities of less unimpeachable value. The need for money has also been diminished through the laying off of men from work and a swiftly spreading contraction of general business.

Dividends have been declared upon the following electrical securities: Columbus Street Railway Company; regular quarterly dividend of 1¼ per cent on the common stock, payable December 2 to stock of record November 15. American Railways Company; a quarterly dividend of 1½ per cent, payable December 14 to stock of record November 30. Books close November 30 and reopen December 9.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 16.

New York:	*Closing.*
Allis-Chalmers common	4⅞
Allis-Chalmers preferred	14
Brooklyn Rapid Transit	30¾
Consolidated Gas	83
General Electric	105
Interborough-Metropolitan common	5
Interborough-Metropolitan preferred	15
Kings County Electric	85
Mackay Companies (Postal Telegraph and Cables) common	46½
Mackay Companies (Postal Telegraph and Cables) preferred	51
Manhattan Elevated	106
Metropolitan Street Railway	29
New York & New Jersey Telephone	92
Western Union	62
Westinghouse Manufacturing Company	35

Directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent, payable November 30. Books closed November 23 and reopen December 2.

Boston:	*Closing.*
American Telephone and Telegraph	90¼
Edison Electric Illuminating	195
Massachusetts Electric	38
New England Telephone	95½
Western Telephone and Telegraph preferred	—
Philadelphia:	*Closing.*
Electric Company of America	8
Electric Storage Battery common	32
Electric Storage Battery preferred	32
Philadelphia Electric	6¾
Philadelphia Rapid Transit	15½
United Gas Improvement	69½

Directors of the Philadelphia Electric Company have declared the regular semi-annual dividend of 2½ per cent, payable December 16, as registered November 22. Books closed November 23 and reopen December 2.

Chicago:	*Closing.*
Chicago Telephone	113½
Commonwealth-Edison	79½
Metropolitan Elevated preferred	48
National Carbon common	50
National Carbon preferred	99½

ELECTRIC LIGHTING.

OZARK, ARK.—The Altus Gin Manufacturing and Improvement Company, of Ozark, will increase its plant by the installation of a 100-kilowatt alternating-current dynamo, complete with switchboard, etc. Bids are requested immediately.

EAU CLAIRE, WIS.—The new power plant of the Chippewa Valley Electric Railway and Power Company at Menomonie has been completed and put in operation. Thirty-three thousand volts is being transmitted to the power station in this city.

ST. JAMES, MO.—James Bright has obtained a franchise for supplying Steelville, Crawford county, with electricity for street lighting. He will generate the electricity at the Evans mill, one mile east of Steelville.

GOLIAD, TEX.—Dr. L. W. Chilton, who proposes to put in operation an electric light plant for Goliad, has the machinery on the ground and a suitable building is being erected. Dr. Chilton is making preparations to have the town wired immediately.

WILMINGTON, DEL.—The Commercial Light, Heat and Power Company has been granted an extension of one year from January 1, 1908, in which to pay the city the sum agreed upon for the privilege of operating its system, viz., $6,250 to be paid on January 1, 1908, and $6,250 July 1, 1908.

SHAMOKIN, PA.—The borough has entered into a ten-year contract with the Shamokin & Coal Township Light, Heat and Power Company for street lighting. The price is $65 per arc lamp per year; $21.60 for thirty-two-candle-power incandescents, and $10.80 for sixteen-candle-power incandescents.

MERIDIAN, MISS.—The annual meeting of the stockholders of the Meridian Light and Power Company was held on November 1. No change in the officers of the company occurred. Plans for the ensuing year were discussed, but no definite conclusions were reached.

DAVENPORT, IOWA—The Independent Light and Power Company has let to the J. C. Settle Construction Company, of St. Louis, the contract for the erection of its building in West Davenport. The new building will be 100 by 118 feet, of concrete block construction.

LAFAYETTE, IND.—At a special meeting of the town board of West Lafayette the Merchants' Electric Light Association was granted a franchise, covering a period of twenty years, to place poles at different street intersections and on the line of contiguous lots and string wires for the purpose of furnishing the people of West Lafayette with heat, light and power.

BILLINGS, MONT.—The Yellowstone River Power Company has filed articles. The purpose of the company is to furnish electric power by means of which an electric light system and a street railway will be operated in Billings. The capital stock is given as $500,000, and the term of incorporation is forty years. Christian Yegen, Peter Yegen, Fred T. Mashaw, Fred Inabnit and Charles T. Stewart are the trustees named in the articles.

SAN RAFAEL, CAL.—The Snow Mountain Electric Power Company, a new concern backed by former United States Senator Felton will shortly enter the field. The company has been in existence but a short time but already has erected several substations and strung a number of miles of high-tension wire in Sonoma and Mendocino counties to carry the current from the central power plant at Snow Mountain which is 150 miles from San Rafael.

ALBANY, N. Y.—Under the condition that they furnish gas and electricity to the village of Irondequoit, at a price not to exceed that prevalent in the city of Rochester, the Rochester Railway and Lighting Company has obtained permission from the village authorities of Irondequoit to lay down pipes and string wires for the purpose of supplying light. Under section 68 of the Public Service Commission law, the approval of the commission is necessary before this permission become effective.

BALTIMORE, MD.—The Consolidated Gas, Electric Light and Power Company is preparing to make extensive improvements to its substation at Penn and Pratt streets, and bids have been asked. The wooden roof of the station is to be replaced with steel trusses supported on steel columns, and the whole is to be covered with slag and book tile. There will be a large skylight running the entire length of the building, and the front wall will be built to resemble a two-story structure. A wire tower will provide a safe height for wires and cables.

LOCKPORT, N. Y.—The Public Service Commission of the Second District has given a decision permitting a new corporation, the Lockport Light, Heat and Power Company to purchase the Lockport Gas and Electric Company and its competitor, the Economy Light, Fuel and Power Company, of Lockport, but forbidding the new company to issue securities for a capitalization above $700,000, equivalent to the total issues of the two old companies. The new concern desired to issue stock and bonds to a total of $1,200,000. It is also made plain in the decision that increases in the price of gas and electricity will not be permitted.

LYNCHBURG, VA.—C. W. Hancock & Sons, of this city, have secured a contract with the company owning the Natural Bridge property for the erection of a concrete dam 200 feet long and thirty-five feet high in Cedar creek, which passes under the Natural Bridge. The dam will be located half a mile below the bridge and the water will be used to develop 100 horse-power which is to be utilized in an electric power-house. It is the intention of the hotel company to light the grounds under and about the bridge; the road leading from the railway station to the property, as well as to supply automobiles, which will be used to carry visitors to and from the railway station and about the grounds sight-seeing.

TORONTO, ONTARIO—The engineers of the hydroelectric power commission have completed surveys for the main transmission lines from Niagara Falls to the municipalities in the Western Power Union, and have been engaged on a survey of several branch lines. The main lines are from the falls to Hamilton, from the latter place to Toronto, from Hamilton to Brantford, Woodstock, Ingersoll and London, and from Hamilton to Guelph, Hespeler, Galt, Berlin, Stratford, St. Marys and London. A loop system is contemplated in the event of all or most of the municipalities definitely deciding upon the adoption of the power scheme. As the lines would be duplicated, a break-down in the service would be a practical impossibility. The total length of the main loop will be about four hundred miles.

MARINETTE, WIS.—A. W. Wilson and A. L. Gillette, representing Chicago capitalists, have applied to the Marinette city council for a franchise to light the city. It is the first application of the kind since the passage of the new public utility law. Under this law the present lighting company has a monopoly lighting franchise unless a certificate of necessity can be secured by a competing company from the state railroad commission. The applicants for the franchise expect to demonstrate that they can furnish light to the city at one half the present cost by means of a water power on the Peshtigo river. The certificate of necessity provision in the new public utility law was written especially to meet a contingency of this kind. The promoters say they will also build an interurban line in connection with their water-power development.

OAKLAND, CAL.—A suit to condemn the right of way across property in Washington township owned by Miriam H. Haines, a minor, has been filed by the Bay Counties Power Company. The strip is sought to afford space for the erection of a line of poles carrying current from a power-house in Colgate, Yuba county, to this city. This suit discloses the plan of the company to double its service into this city, as it already maintains one high voltage line from Colgate to Oakland. The route of the proposed line will pass through Sutter, Davis and Solano counties and will cross the straits of Carquinez near Port Costa. The eastern bay shore will be followed into North Berkeley, but the line will be carried east of Oakland as far as Elmhurst. From there it will turn west and be carried to its Oakland terminus. The Oakland Gas, Light and Heat Company's plant will receive the power at this end.

JEFFERSONVILLE, IND.—The United Gas and Electric Company has announced that the price for incandescent lights on and after November 1 will be twelve cents per kilowatt-hour the first

ten kilowatt-hours; eleven cents for the next twenty, ten cents for the next twenty and six cents for all over fifty kilowatt-hours. Bills rendered December 1 will be on the new basis.

LONDON, ONTARIO—The city council has decided to submit a by-law to the people at the January election providing for the expenditure of $235,000 for transmission of Niagara power to the city.

CINCINNATI, OHIO—The village of Delhi has given the Union Gas and Electric Company a franchise to install its lines. An ordinance was also passed to regulate the price of gas and electricity.

CHINOOK, MONT.—The city of Chinook has voted bonds for the construction of a municipal light plant. Work will be commenced at an early date, and before next summer the city should be lighted by electricity.

GREENFIELD, MASS.—The selectmen have granted a franchise to the Franklin Electric Light Company to erect and maintain a line of poles and wires from Turners Falls for the purpose of supplying this village with electric lights.

CHEYENNE, WYO.—The mayor has ordered the Cheyenne Light, Fuel and Power Company to remove its pipes and wires from the city streets, declaring forfeited the franchise under which the company does business. This action has been taken as a result of the poor service given.

ENCAMPMENT, WYO.—The Big Chief Copper Company is making arrangements to establish an electric plant on Cow creek. The company's mine is located near Silver Lake, which empties into the creek named, and the plan is to dam the outlet to this lake and there establish a reservoir. The plant will be on the creek at a point so far below the level of the lake as to give a good fall. It is the company's intention to run its own machinery and also furnish power to any and all contiguous properties.

ST. LOUIS, MO.—Dissatisfied with the prices they are paying for electric light, citizens of St. Louis county are discussing plans for the organization of a company to compete with the corporation now furnishing electric light in the county. It is proposed that a stock company be formed among citizens and that a plant be established in the neighborhood of Clayton. There are four electric light companies doing business in St. Louis county, but none interferes with the business of the others. The General Service and Development Company has a franchise covering the entire county; the King Electric Company has a franchise in St. Ferdinand and Central townships, with a special franchise in Ferguson; the Suburban Electric Light and Power Company furnishes light in Webster Groves and surrounding territory, and the Carondelet Electric Light and Power Company has a few customers south of the city limits. None of the franchises is exclusive and it is the plan of the proposed company to obtain a franchise covering the entire county. Each person using electric light is to be solicited as a stockholder in the new company.

INDUSTRIAL ITEMS.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., opened its new factory with a dance for the employés and their friends on November 8. The factory contains four stories and a basement, and gives the company a fine equipment for extending its line of apparatus.

MATHIAS KLEIN & SONS, Chicago, Ill., have ready catalogue No. 7, which describes and illustrates a complete line of linemen's and construction tools. This catalogue is splendidly arranged, and a double sheet of cross-section paper is interpolated between the leaves of the text. Full descriptions are given, and each piece of apparatus is carefully illustrated.

THE ZOAR BATTERY COMPANY, Zoar, Ohio, has ready for distribution two new pieces of literature, entitled, respectively, "Battery Troubles," and "Zoar Storage Batteries." The first mentioned gives some very interesting and instructive information concerning the charging of storage batteries, the testing of the electrolyte, the capacity of the battery, the adjustment of coils, and directions for placing the battery out of commission. This literature will be sent to any one interested upon request.

THE RAYMOND CONCRETE PILE COMPANY, New York city, has announced its removal to 140 Cedar street, in the new West Street Building. The company has been awarded the contract for the concrete pile foundation for the North Shore yards of the Long Island Railroad, Long Island City. The conduit, which will be of concrete, will be 1,100 feet long and will carry the feed wires for the electric system. The application of concrete piling to conduit foundations is a novel one, this being the first time such use has been made on a contract of any magnitude. The Abbott-Gamble Company is the general contractor.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, is calling attention to "Noark" National Electrical Code fuse plugs. These plugs are fitted with "Noark" fuses, which may be used interchangeably with other "Noark" devices of the National Electrical Code standard. They are furnished in two sizes—one to thirty amperes, and thirty-one to sixty amperes, for 250-volt circuits. A folder describes the "J-M" asbestos lead-joint runner. This is for making lead joints in cast-iron gas and water pipe. It is made of specially prepared pure asbestos rope of square cross-section, having a ferrule on each end, and provided with a clamping device for fastening in place on the pipe. Another folder describes and illustrates asbestos papers, roll board, sheet board, building felts, etc.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

American Association for the Advancement of Science. Chicago, Ill., December.

American Society of Mechanical Engineers. Annual meeting, New York city, December 3-6.

South Dakota Independent Telephone Association. Mitchell, S. D., January 8-9, 1908.

Chicago Electrical Show. Coliseum, Chicago, January 13-25, 1908.

International Independent Telephone Association. Annual meeting, Chicago, Ill., January 21, 22 and 23, 1908.

Nebraska Independent Telephone Association. Next meeting, Omaha, Neb., January, 1908.

Record of Electrical Patents.

Week of November 12.

870,551. CENTRAL-ENERGY TELEPHONE SYSTEM. Francis W. Dunbar, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A signal-controlling electromagnet is bridged between the two limbs of the talking circuit.

870,555. CONTROLLER. Frank W. Garrett, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. A blow-out magnet having a plurality of polar projections is used.

870,564. THIRD-RAIL ELECTRIC RAILWAY SYSTEM. Charles Kozesnik, New York, N. Y. A sectional hollow third rail.

870,574. FIRE-ALARM SYSTEM. Charles W. McDaniel, Kansas City, Mo. A combined alarm and telephone system.

870,577. ELECTRICAL WATER HEATER. Emil Naumer, New York, N. Y. A heater pipe of hollow carbon rods.

870,595. CONTROLLER. Lewis L. Tatum, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. The circuits are controlled by cam-operated snap switches.

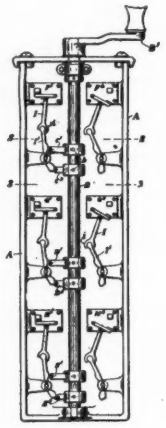
870,596. MOTOR CONTROLLER. Lewis L. Tatum, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. The circuits are controlled by oiled switches.

870,611. SERIES SHUNT FOR DYNAMOELECTRIC MACHINES. Henry C. Beekley, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. A frame-supporting resistance which is made up of removable sections.

870,621. ELECTRIC RAILWAY SIGNALING SYSTEM. Norman P. Fraser and William Gribben, Carsonville, Mich. The signals are controlled by contacts on the train.

870,622. ELECTRIC SIGNALING SYSTEM. Willard H. Gilman, Medford, Mass., assignor, by mesne assignments, to International Telemeter Company. The signals are controlled by current impulses of different character.

870,632. ELECTRICAL MEASURING INSTRUMENT. John M. Lea, Chicago, Ill., assignor to International Electric Meter Company, Chicago, Ill. A stationary and a movable coil are magnetically linked by a laminated core.



870,595.—CONTROLLER.

870,637. INCANDESCENT LAMP GUARD. Charles Molitor, Chicago, Ill., assignor to James H. McGill, Valparaiso, Ind. A wire guard.

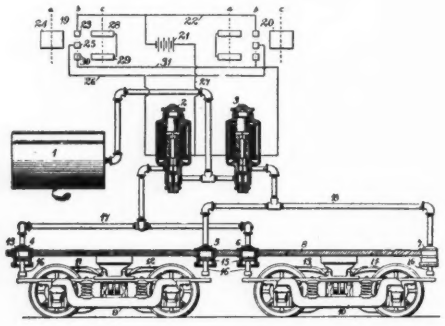
870,674. APPARATUS FOR ELECTROCHEMICAL ANALYSIS. George A. Guess, Silverton, Colo., and Herbert E. T. Haultain, Nelson, British Columbia, Canada. The terminals for each vessel are in sets of three.

870,675. ELECTRODE. George A. Guess, Silverton, Colo., and Herbert E. T. Haultain, Nelson, British Columbia, Canada. A corrugated sheet electrode.

870,688. AUTOMATIC ELECTRIC-STORING DEVICE. John W. Ringer, Castleton, Ind. A commutating switch.

870,691. PROCESS OF PRODUCING POROUS BARIUM OXID. Hermann Schulze, Bernburg, Germany. Barium carbonate is mixed with carbon and melted.

870,714. ELECTROCHEMICAL PROTECTOR. Frank B. Cook, Chicago, Ill. The contacts, under spring pressure, are kept apart by a fusible cement.



870,802.—VEHICLE CONTROL SYSTEM.

870,736. ELECTRIC FIXTURE. Harry R. Mitchell, North Yakima, Wash. An adjustable fixture.

870,737. STREET AND STATION INDICATOR. Charles A. Myers, Niagara Falls, N. Y. A device operated by a magnetically operated ratchet wheel.

870,755. TROLLEY-POLE GUIDE. Lewis A. Allen, Passaic, N. J. A guiding roller follows the wheel.

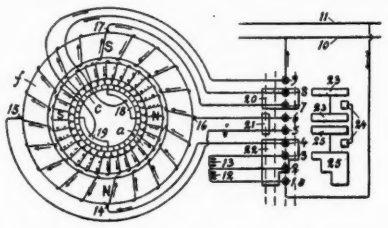
870,802. VEHICLE CONTROL SYSTEM. Norman W. Storer, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Means are provided for adjusting the point of application of the resultant propelling force to the truck.

870,803. ELECTRICAL MEASURING INSTRUMENT. Charles B. Twing, Philadelphia, Pa. Temperature compensation is effected by varying the reluctance of the magnetic circuit.

870,852. SPEED-INDICATOR AND DISTANCE RECORDER. Ralph Shipman, Sunbury, Pa. A time-operated device.

870,891. AUTOMATIC GAS CONTROLLER. Joseph C. Landes, Collegeville, Pa. A thermostatic device.

870,892. ALTERNATING-CURRENT MOTOR. Robert Lundell, New York, N. Y. A commutator motor with two sets of brushes.



870,893.—ALTERNATING-CURRENT MOTOR.

870,893. ALTERNATING-CURRENT MOTOR. Robert Lundell, New York, N. Y. A commutator motor with two wide short-circuiting brushes.

870,935. AUTOMATIC SWITCH GOVERNOR. Leonard Colson and Charles Gebauer, New York, N. Y.; said Colson, assignor to said Gebauer. A switch for a projection lamp.

870,938. ALTERNATING-CURRENT GENERATOR. George H. Cove, Roxbury, Mass., assignor of one-half to Frank R. Kimball, Boston, Mass. The armature coils are carried on an oscillating pendulum.

870,946. CONTROLLING MECHANISM FOR ELECTRIC CIRCUITS. Taylor T. Fogel, Reading, Pa., assignor of two-thirds to Alfred J. Mason, Reading, Pa. An automatic rheostat.

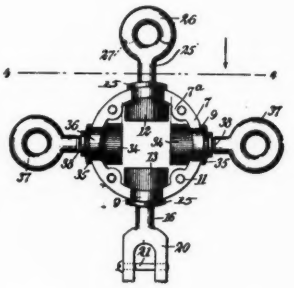
870,950. TROLLEY. Walter P. Gisske, Los Angeles, Cal. Guard arms are attached to the harp.

870,954. ELECTRICAL SPARKING DEVICE FOR EXPLOSIVE ENGINES. William B. Hayden, New York, N. Y. A magnetic interrupter.

870,970. ALTERNATING-CURRENT METER. Robert C. Lanphier, Springfield, Ill. The rotating conductor is submerged in mercury.

870,973. STORAGE BATTERY. Homer E. R. Little, New York, N. Y. A zinc battery.

870,985. CARBON ELECTRODE FOR GALVANIC ELEMENTS. Wilhelm Möllenbruck and Wilhelm Dielmann, Dusseldorf, Germany, assignors to Herman Peltzer, Dusseldorf, Germany. The electrode is formed of carbon rods embedded in the depolarizer.



871,002.—INSULATING FIXTURE.

870,999. TROLLEY HARP. Samuel T. Simmons, Columbus, Ohio. A swiveling trolley.

871,002. INSULATING FIXTURE. Louis Steinberger, New York, N. Y. A four-armed strain insulator.

871,042. TELEPHONE EXCHANGE. Samuel A. Norstrom, Chicago, Ill., assignor to Casper L. Redfield, Chicago, Ill. The calling mechanism for an automatic exchange.

871,043. TELEPHONE EXCHANGE. Samuel A. Norstrom, Chicago, Ill., assignor to Casper L. Redfield, Chicago, Ill. An automatic telephone switch.

871,092. SELECTING DEVICE FOR TELEPHONE EXCHANGES. Frank A. Lundquist, Chicago, Ill. An automatic telephone set.